

MARCH 1970 50 CENTS

Popular Science

THE *What's New* MAGAZINE

Now You Can Skim
Over Hill and Bog,
Snow and Water, in the
Amazing New Air Cycle

What Is Congress Doing
About Safer Products
for Your Home?

How Apollo 13 Will Probe
the Moon's Interior
By WERNHER von BRAUN

Now the Wankel Is Ready
for Your Future Car

We Hit the RV Trail!
Personal-Use Reports
on Six Different Kinds
of Recreational Vehicles

Engineering the New
Mechanical Heart

Vacation Homes
You Buy by Mail

The Crazy, Tricky,
Wonderful Sport
of Island-Hopping

Use Report on a
100 Radial-Arm Saw

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A Unique Patio Table



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Gauges that gauge, spoilers that spoil, and scoops that scoop.



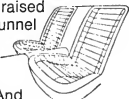
What's this? Detroit pushing functional styling? Wouldn't you know who. Pontiac.

We decided to give our designers and engineers their heads. And what they came up with is styling that works. Aerodynamically. In four totally new Firebirds. Two of which you just might find particularly stirring.

Firebird Formula 400 (the blue beauty shown left). We asked ourselves how many passengers we might seat comfortably. The answer was four. So Formula 400 has bucket seats front and rear.

Then, we raised the drive line tunnel between the seats to get more room for spring travel. And the result is a decided lack of the typical sports car jolts.

Formula 400 also has a bigger stabilizer bar up front. A brand-new stabilizer bar in the rear. And standard front disc brakes. For those roads that feature curves. The



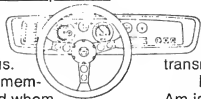
fastest variable-ratio power steering around is available for such conditions, too.

The standard 330-hp, 400-cubic-inch V-8 should be enough for about anyone. Just in case somebody disagrees, however, there's a 400 Ram Air V-8 you can order.

Should you do so, the scoops perched on that fiberglass hood will scoop. Really scoop. Take a glance at the available full complement of honest-to-gosh gauges if you doubt us.

Just remember who told whom about functional styling.

Firebird Trans Am (the one shown right that isn't blue). Ah, what a little road testing can do. What it can do is help you develop a front air dam



and side air extractors that put a 50-lb. downward pressure on the front end. At

turnpike speeds. It can show you how effective air dams are at the wheel wells. It can lead you into developing a rear spoiler that puts 50 lbs. of pressure on the rear end.

Also at turnpike speeds. And it can convince you that a

shaker hood with a rear-facing inlet is effective for providing air to a 345-hp, 400-cubic-inch Ram Air V-8.

It can also tell you how it all works with the Hurst-shifted wide- or close-ratio 4-speed transmission you can order.

Now you know why Trans Am is our most sophisticated Firebird. In fact, the only thing that doesn't function is the un-subtle stripe running the length of the car. But maybe it does something for you.



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MONTHLY

THE *What's New* MAGAZINE™

MARCH 1970 Founded in 1872/Vol. 196 No. 3

HIGHLIGHTS OF THIS ISSUE:

The Amazing Air Cycle PAGE 53

You can skim over hill, bog, water, ice at speeds of 30-40 mph in this ACV that costs only \$1,300. What's its secret?

How Apollo 13 Will Probe the Moon's Interior

By WERNHER von BRAUN PAGE 56

Spectacular Saturn rocket-stage lunar crash and a key heat-flow experiment will help to tell us what's inside the moon.

Engineering the New Mechanical Heart PAGE 64

The fascinating search for a major medical miracle is close to success.

We Hit the RV Trail! PAGE 78

Personal-use reports by PS editors who drove six different kinds of recreational vehicles a total of more than 17,000 miles.

A Patio Table with New Ideas PAGE 104

Build this beautiful table with inlaid tiles and a lazy Susan.

COVER PHOTO BY CARL HOWARD

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EDITORIAL OFFICES:

355 Lexington Ave., New York, N. Y. 10017

PUBLISHED MONTHLY BY Popular Science
Publishing Co., Inc., 355 Lexington Ave., New
York, N. Y. 10017.

SUBSCRIPTION SERVICE

New or Renewal Orders: Send to: Popular Science
Subscription Department, Boulder, Colorado
80302. One year \$5, 2 years \$9, 3 years \$12 in
U.S. and its possessions. One year \$6, 2 years
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\$8.50, 2 years \$16, 3 years \$23. Single Copy
50¢ in U.S. and 60¢ in Canada & elsewhere.
Subscription orders processed electronically. •
All subscription adjustments: Write to Robert
Harlan, Popular Science, P.O. Box 1083, Boulder,
Colorado, 80302. For change of address allow six
weeks; please give both old and new addresses.
Notices of undelivered copies (Form 3579) to
Mr. Harlan. • Second class postage paid at New
York, N.Y., and at additional mailing offices.
Entered as second class matter at the Post Office
Department, Canada. Printed in U.S.A.

ADVERTISING OFFICES

NEW YORK: 355 Lexington Ave. (10017), Tel.
212-687-3000; CHICAGO: 401 N. Michigan Ave.
(60611), Tel. 312-527-0550; DETROIT: 1716
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This Sub for Hire! By Bob Gannon

PS' intrepid reporter describes his adventures aboard the search-and-rescue sub Aluminaut

The Invisible World in 3-D By C. P. Gilmore

A look at the amazing world of the electron scanning microscope

New "Concept" Cars Are Smog-Free

By Jan Norbye and Jim Dunne
An exclusive report from Ford, by our automotive editor and Detroit editor

World's Highest-Pressure Chamber

By Cmdr. Scott Carpenter

The famed astronaut/aquonaut tells you about the remarkable test facility now being built in Buñalo, where pressures equivalent to a sea depth of 5,600 feet will help gauge man's adaptability to an underwater environment

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By E. F. Lindsley

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views... and the editors
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Northwest Passage

In "I Saw Them Crunch Through the Northwest Passage" [Jan.], you stated the Manhattan's course 90 degrees contrary to that shown on my charts. Passage through McClure Strait has to be in a northwesterly direction, not northeast. And had the trip through that Strait been successful, the general direction to the Alaskan coast would have been to the southwest rather than southeast. Nonetheless, it was a remarkable voyage.

F. F. KLEINWECHTER
Fort Worth, Tex.

Right you are—on both counts.

... The Manhattan cracked its way across the top of the world in the unimaginative, traditional brute-force-and-sheer-power method. Several years ago, it was suggested that future ice breakers be built with hulls heated by nuclear fuel. The skin of the ship would be heated either electrically or with steam, then it would melt its way through the ice like a hot iron through paraffin.

GEORGE BAGLIETTO
San Francisco, Calif.

Back to nature

I am becoming less and less enthusiastic about the dune buggies, snowmobiles, trailbikes, and other vehicles that appear in your pages each month. Hasn't anybody given a thought to the impact upon our wilderness areas and the rural environment in regard to these noisy air-polluters? For those having a legitimate need to travel rapidly in rough terrain, these machines may have an interest. The rest of us would do better to get out and walk.

R. J. KING, Los Angeles

... It's fine to see that POPULAR SCIENCE is increasing in size and quality. But how about having a few pages of your magazine devoted to how science is helping to solve some of our ecological problems? PS seems to place an undue emphasis on the physical sciences. As a result we read a lot about all-terrain vehicles, but little about the quality of the terrain. Let's not forget that science means more than just technology.

ROBERT WANER
Long Beach, Calif.



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HOWARD P. HOLMAN
Belle Glade, Fla.

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I. MITCHEL MILLER, Cheney, Wash.

... I like the idea of enlarging your healthy magazine to large economy size.

ALESON LAKE, Morehead, Ky.

Sees a rub in gravity-free vehicle

"The Incredible No-Torque Walking Machine" [Jan.] uses a novel power transmission that undoubtedly has unique characteristics. Unfortunately, the statement that the wheels "rely on gravity rather than friction for traction" is fundamentally wrong.

There are tractive effects which do not depend on friction. If the pods dig in, the action is more gear-like than frictional in character. This depends on the deformability and cohesiveness of the surface and is clearly not what the author had in mind when stating that the wheels won't spin on ice (if so, they haven't tried a steep enough patch).

The force needed to drive such a vehicle produces an equal and opposite reaction in the ground which is transmitted by friction. The Rotoped, like the human walking machine it copies, depends on friction.

D. G. SCHWEIKERT, Ph.D.
Berkeley Heights, N.J.

The author—Dave Scott, our European Editor—says that the Rotoped relies on gravity rather than friction for traction. The self-propelled wheel does rely to a limited extent on friction-based adhesion with the surface, but this need is small—similar to a man walking gingerly on ice as compared to running.

STOL's takeoff distance

Your article "New Waco STOL Minerva Has Real Get-Up-and-Go" [Dec.]



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autumn day
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send
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Mother.

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was interesting, but in listing specifications you show the takeoff distance as 320 feet over a 50-foot obstacle. I think if you will check on this you will find it just about leaves the ground in 320 feet.

How about doing a piece on the Maule "Strato-Rocket"? This is a four-place plane with the same engine as the Waco. It will fly slower, faster, and climb better than the Minerva—and will cost about \$8,000 less. I am operating a Maule M4-210 on floats and find it is a real performer even though the Continental 210 in it has less horsepower than the Strato-Rocket 220.

WALT PEDERSEN
Sterling, Alaska

The specs said 320 feet over a 50-foot obstacle at STOL weight. The Minerva's weight empty is 1,360 pounds. Max. gross is 2,340. STOL weight is about 1,770 pounds. The manufacturer's claim is 320 feet over a 50-foot obstacle at about 1,770 pounds. At max. gross they claim 875 feet over a 50-foot obstacle.

Soma solutions

"Match Wits with Danish Gamemaster Piet Hein" [Jan.] is very interesting. But I think the claim that there are 1,105,920 ways to assemble the puzzle is



rather misleading. I say that there are only 46,080 ways to assemble the puzzle—but Mr. Hein is using 24 orientations of the cube for each one. All you would have to do is turn the cube around, and you would have another solution to the puzzle.

DAVID JEWELL, Lexington, Ky.

How did crowbar get its name?

I'm sure I don't know where the striking hammers got their names [Shop Talk, PS, Jan.], but all you need do to find out about the crowbar is check your library's etymological dictionary—"Crowbar: a bar with a strong beak like a crow's." One down, two to go.

B. TILLSON, Ramsey, N.J.

... The crowbar, as we know it today, was once called a crowbar—to move a movable object against or away from another object. Some time, somewhere, someone lost the big D.

N. CASE, El Paso, Tex.

... My Random House unabridged says that a crowbar is called that because some of the first ones looked like they had a beak. Presumably like our

modern pinch bars and those used for moving railroad cars.

MIKE FIRTH, Iowa City, Iowa

Webster's 3rd edition *New International Dictionary* says it's "probably so called from the forked end it sometimes has, likened to a crow's foot."

Oxford English Dictionary says the word first occurs in 1825; before then it was called a crow.

Rating the Norbye/Dunne Report

Norbye and Dunne have done it again. This time ["Detroit's Economy Cars," PS, Jan.] in more glaring fashion than usual. The Maverick runs the lane change much better than the competition (for some reason this "surprised" Norbye and Dunne). It was more stable and quiet. It had better styling (reduced to "cute" in the article). After all this, guess which car was neglected in the summary? Once again, congenital anti-Ford bias rears its ugly head. Maverick sales indicate that people just go along buying the better cars and enjoying superior performance.

CHARLES H. ZIERDT
SR., Ph.D.
Rockville, Md.



We try to give all the facts so you can have a basis for forming your own opinions. Then, of course, the decision is up to you.

As for anti-Ford bias, the record shows Norbye/Dunne picked a Ford product over the competition in five out of nine of their reports published in 1969.

Tune-up center

I was unable to purchase Sun model TAC Timing Advance Control for \$36—sixth item on your list ["A Home Diagnostic and Tune-Up Center for Your Car," Jan.]. The Sun electronic distributor tester is over \$200.

MARVIN M. EDEN, Locust Valley, N.Y.

Author Richard Day regrets that a misunderstanding between Sun and himself caused him to list the Sun EDT, which costs \$214. A low-cost alternative would be the Heath ID-11 powered timing-light accessory for the Heath 10-20 ignition analyzer (item 7). It costs \$19.95.

... The 16-page special on the "Car Diagnosis Center" mentioned a spark-plug cleaning tool. What is it, and where can you buy one?

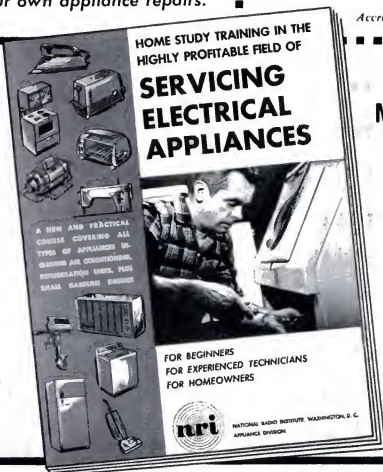
W. S. BLACK, Evergreen, Ill.



The spark-plug cleaning tool (above) is available from J. C. Whitney & Co. 1917 S. Archer, Chicago.

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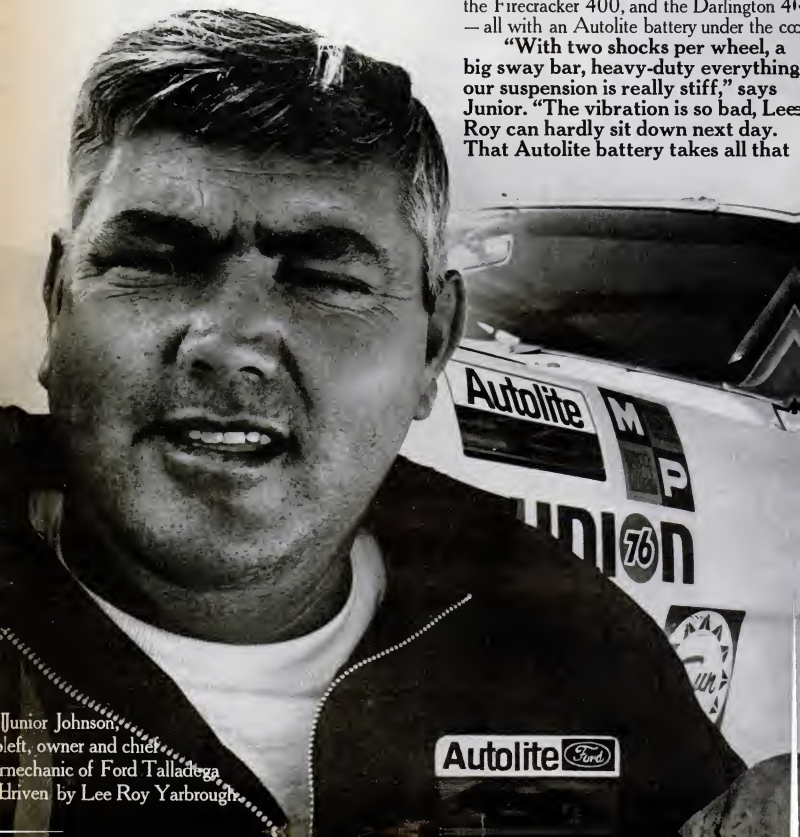


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**"We sprung our Firecracker 400
passenger rig. The vibration was really
You're tougher on yours." — Junior Johnson**

Junior Johnson sets up racing cars with the same charging determination that made him a legend as a driver. By mid-1969, his Ford and Mercury's, with Lee Roy Yarbrough driving, had won the Daytona 500, the World 600, the Firecracker 400, and the Darlington 400 — all with an Autolite battery under the hood.

"With two shocks per wheel, a big sway bar, heavy-duty everything, our suspension is really stiff," says Junior. "The vibration is so bad, Lee Roy can hardly sit down next day. That Autolite battery takes all that



Junior Johnson, left, owner and chief mechanic of Ford Talladega. Driven by Lee Roy Yarbrough.

Autolite 

winner about 400% stiffer than a ough on our Autolite battery.

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tougher. You
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That drains
fluid and**

**power. And then you don't let the gas
station fellow take time to refill
your battery."**

That's okay with Autolite. Its Sta-Ful
reservoir has up to 3 times more water above the
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about three times a year.

**"We change batteries like socks.
You'd stick with yours for 40,000
miles—and never think about the dust
and salt and stuff piling up on the
battery, and making a nice little
path for electric leaks."**

With Autolite, you can forget electric
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Next time get an Autolite battery. It
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'How I fish deep holes and drop-offs with the Arbo-Gaster'



by
DICK KOTIS
President

Fred Arbogast Co., Inc.

I believe game fish like bass avoid bright light. That's why you'll get more strikes during the day by concentrating on deep holes and steep drop-offs. Try the Arbo-Gaster, a deep diving bait. I retrieve it as fast and hard as I can crank the reel to get it really deep—actually bumping along the bottom. Be sure to keep your rod clear of the boat to prevent damaging it because you'll get hard hits.

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Detroit Report...

FORD WILL INTRODUCE A FOUR-DOOR MAVERICK next fall. It will be built on a 111-inch wheelbase, same as the '69 Falcon (the '70 Falcon has a 117-inch wheelbase—see page 97). When the Falcon was upgraded to the low end of the Fairlane/Torino line, Ford found itself without a four-door US-built sedan with anything less than 117-inch wheelbase. What's more, Ford now has no small four-door sedan (other than the Cortina, practically unchanged since '67).

Ford's engine for the new mini-compact Pony will be built only in Germany, not both there and in the U.S., as reported last month. The two-liter (122-cu.-in.) OHC engine is brand new, so Ford could set up the assembly line anywhere. But the size of the four-cylinder engine, just right for Ford's small European cars, was the deciding factor in picking the overseas supply point. The engine will be used in German and English Fords as well as the American Pony. Smaller engines of 1.2- and 1.4-liter displacement of similar design will also be built in Germany and England.

General Motors' XP887 (GMini) will be built in three versions: a basic sedan, a fastback sporty model, and a station wagon. All will be two-door cars with seating for four passengers. The three-door sedan (PS, Feb.) will be a higher-priced version of the basic car. Prices will spread from a low of about \$1,900 to as much as \$2,300. With all available options installed, delivered prices could nudge \$3,000.

Oldsmobile's announcement of an anti-skid system for the Toronado points up an unfair advantage in the automobile business. The Olds system is made by Delco-Moraine Division of GM, and it is similar to the systems perfected by Kelsey-Hayes, Bendix, and other suppliers. While Delco-Moraine was still developing its anti-skid, these outside suppliers were demonstrating their systems for GM engineers in hopes of selling to the huge auto company. Thus GM had the benefit of all the suppliers' research in developing the Delco system. While the suppliers' units were ready for production many months before Delco, GM held off until Delco was ready to produce its unit, thus depriving GM drivers of this safety option for over a year.

One of Ford's most successful cars was the old two-seat Thunderbird, and Detroit plans to revive the idea in the early '70's. Challenger, Barracuda, Mustang, and Cougar are slated for much smaller bodies in 1973. Ford will use the Maverick shell; the old two-seat style will be one model offered. Two reasons for this change: Sporty cars have grown too much in the past six years to be really sporty. On fastback models, back seats in these cars are too small to be usable.

Detroit is betting that the sporty car buyer of the future really wants a smaller package and its side benefits—smaller engines, better performance and handling, easier driving.

Among the sourest jokes in Detroit is the federal government's five-year plan to develop an alternative to the "dirty, noisy, standard car motor." HEW proposes to spend \$45 million on the project, not counting the vehicles involved. Government plan reads like a wishful dream. The schedule calls for "new models by 1971, fleet testing by 1973, purchasing by 1974, commercially available vehicles by 1975."

While GM is not saying so right out, it is clear that the new roof design of Camaro and Firebird will afford greatly increased rollover protection. The roof is made of two pieces of metal, bonded together like the inner and outer panels of a deck lid. This gives extraordinary strength for little increase in weight, since it makes a kind of sandwich construction. GM plans to extend this roof to its 1971 "C"-body cars—Cadillac, and the big Olds and Buicks—and eventually equip all cars with the design. While Pontiac and Chevy stress the sound-absorption benefits of the roof, observers believe it is a key step in GM's intention to enclose passengers in a "safety cage."

Why did Lear abandon the steam car? The advantages of the gas turbine became more evident the deeper he got into steam-power research, William P. Lear told a group of lubrication engineers in New York last month. He admitted he had "invested" \$6 million in the steam-car project, and is stubborn enough to continue steam-engine research to the tune of \$200,000 a month. Lear has discarded the deltic engine, and shelved the steam turbine. Latest project? Converting the Lysholm involute screw type compressor to serve as an expander. But the expander is only one of six severe technical problems that separate Bill Lear from a modern steam car. Its chances are about zero, he now feels.

Jim Dunne
Detroit Editor



Transport 110, Super All Traction—Firestone TMs.

It pays to expect the unexpected—

A little talk about camper tires that will take unusual punishment.

You're driving along a main highway at high speed and suddenly you hit a pothole. The kind that jars your teeth. That's the unexpected.

Or you're off in the high country on a summer vacation and the weather man dumps a load of snow. The unexpected again.

Or maybe you make the wrong turn on an old logging road. And you find yourself on the rocky, rutty road to nowhere.

Unexpected? Sure. But isn't it nice to know that you're prepared for it? With reasonably priced tires that are built to take *unusual* punishment. Tires that will do a first-rate job of protecting the major investment you have in your camper.

For example, there's the Transport 110, an all-wheel tire from Firestone with quiet running and long mileage built right in. Moreover, a tire with remarkable impact resistance, and construction that minimizes flex damage.

And for a brawny tire that will really dig in and grab in mud, snow and deep ruts, Firestone makes the Super All Traction. This rear-wheel tire just plain eats up the unexpected!

Firestone makes both these tires with its exclusive Triple-Strength Construction. That's the special way Firestone bonds the tread to the body, reinforces the sidewalls and insulates every cord.

Next time you meet the unexpected, meet it with confidence—and tires by Firestone.



Super All Traction: For long on-highway mileage and superior off-highway traction.

Transport 110: A tough original equipment tire for any wheel position.

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172411



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171884



181461



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184317



178517



180554



180711



175620



180315



180950



155846



182543



157883



177519



163131



176560



110379



176537



150953



182469



181289



175646



17114



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That's right!—you'll have two full years in which to purchase your ten records...and after you do so, you'll have acquired a sizable library of 22 records—but you'll have paid for just 12 of them...and that's practically a 50% saving off regular Club prices!

As a MEMBER you will receive, every four weeks, a copy of the Club's music magazine. Each issue describes the regular selection for that month's interest and almost 300 other records...hit albums from every field of music, from scores of record labels! If you do not want any record in any month—just tell us so by returning the selection card by the date specified...or you may use the card to order any of the records offered. If you don't only the regular selection for your musical

interest, you need do nothing—it will be shipped to you automatically. And from time to time, the Club will offer some special albums, which you may reject by returning the special form provided—or accept by doing nothing.

RECORDS SENT ON CREDIT. Upon enrollment, the Club will open a charge account in your name...you pay for your records only after you have received them—played them—and are enjoying them. They will be mailed and billed to you at the regular Club price of \$4.98 (Classical, occasional Original Cast recordings and special albums somewhat higher), plus a mailing and handling charge.

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Recreation Roundup

...on the move with PS

Wild ride in Debbie Special, a 4WD Condor Motorhome that completed the Baja 1,000 race, capped Ford conference. Even the toilet in this tough bird had a seat belt.



By ERIK H. ARCTANDER

We piled out of a luxurious 26-foot Condor Motorhome and into the plush Francisco Grande Motor Inn. The Condor had just carried us 40 miles across Arizona desert from Phoenix Airport to this oasis, where Ford R/V people had things to show and tell.

Before that afternoon and the next day were over, we'd examined a score of exciting R/Vs, heard some straight talk, driven a variety of rigs over back roads, eaten a barbecue lunch in mid-desert, and raced the Debbie Special (photo above).

Stop overloading! Robert C. Honke, truck sales training and recreation manager, delivered Ford's most urgent message: R/V owners are dangerously overloading their cars with excessive tongue loads and their trucks with over-weight campers.

Honke described the experience of Joe Doakes, mythical neophyte. Joe took his dealer's advice and bought a middle-series pickup with heavy-duty options and a GVW (gross vehicle weight) of 7,500 pounds. The truck weighed 4,230; the camper 1,800; optional conveniences, camping gear, and people 1,334 pounds. All but 136 pounds of the GVW was used up right away.

Next summer, Joe piled on so much extra stuff—boat trailer, trail bike, and so on—that his pickup was only 100 pounds short of front spring capacity, 18 pounds over rear-axle capacity. He was way beyond the GVW and so tail-heavy that the back was levering up the

front end at the rear axle. Now one good bump could mean disaster from a failing tire, wheel, bearing or axle.

Honke suggested five precautions:

- "Recognize weight—and weight distribution—as factors that can affect the smoothness and pleasure of a vacation trip.

- "Select the right pickup and the right camper so the combination allows taking along the things that make vacation life comfortable.

- "Weigh the combination before a trip. Look in the yellow pages. Trucking firms have scales; so do grain elevators . . . and truck scales are scattered all along our highways.

- "Adjust the weight, if necessary. Shift things around, forward or back, so the total is balanced the way the pickup is by itself. Or take things out if there's too much weight."

Take nothing for granted. Some truck campers are just too heavy in general. Honke added; others have poor loads that guarantee bad balance. And camper manufacturers don't always give accurate weights; nor do all trailer makers give accurate tongue loads.

Ford has backed up this tough talk with a 24-page booklet, *Ford for Recreation, 1970 Cars & Trucks*. It tells what loads Ford cars and trucks can handle, recommends optional equipment for each of three R/V weight classes. Your Ford dealer should have one.

Big shakeout ahead. Though R/V production keeps rising, Bob Honke told us, the rate of increase has leveled off for travel trailers, declined for pickup and

tent campers, is increasing only for motor homes. In 1970, he predicted, the industry will build 195,000 travel trailers, 165,000 pickup campers, 121,000 tent trailers, 30,000 motor homes—mostly small ones and van conversions.

Rec-vehicle buyers are becoming much more conscious of value, he asserted. This is ending the early frantic boom. Just as the auto industry narrowed down from 500 companies in the 1920s, today's 570 R/V builders will thin out.

Ford men believe that concentration of capital will revolutionize R/V design, production methods, use of materials, and distribution. The result: R/V values will approach those of mass-produced autos and trucks.

"Why should a pickup camper, for instance, cost as much or more than the pickup that carries it?" Honke asked.

"The vehicle is a marvel of engineering and sophistication, with mass production making it available at a reasonable price. The camper is a plywood box held together with nails and glue driven or spread by hand." (See the article on Ford's MiniHome that appears on page 80—a camper that is a conversion of the popular Econoline 200 SuperVan.)

More campsites coming. Private capital is moving into campsite development. The KOA franchise system is growing phenomenally. Gulf Oil is setting up a national campground system plus stop-over spaces at many Gulf stations. A Florida developer is selling trailer lots.

Actually, Honke concluded, there are plenty of campsites available now, if you search for them. Only the most popular campgrounds are crowded.



Mini-trailer adds a two-bed room to the MiniHome, a Ford van conversion. The MiniHome's front seats swivel to the rear.



A wide pull-out bed and lush inside finish are the Spoiler's strong points. This Ford van conversion by Contempo Campers also



has roof vents. Like the MiniHome, it can be ordered with a wide range of optional appliances through Ford dealers.

That's what one off-road magazine editor had to say about our SCOUT.

Another said, "...has to be reported as even better than the best SCOUT ever built." Still another joined in with, "This SCOUT is a whole new thing now!"

Getting off-road editors enthusiastic takes some doing. They're hard to please. But we did it. Because under that familiar sheet metal beats the heart of a brand new beast. The SCOUT 800A.

Here's what all the talk is about: **New muscle.** A new V-8 that's 304 cu. in. big, 193 horses strong... and hardly knows the difference between a steep hill and a straight road. In

independent tests, the SCOUT 800A beat the wheels off of every vehicle in its class in 0-60 runs.

An option with an option. A new 3-speed automatic with a single-lever transfer case. Shiftable, so you can use it like a manual. And all you'll miss are the clutch-foot cramps. Or notch it into "Drive" and get automatic advantages. Things like greater torque multiplication and smoother take-offs. Better towing ability. Better on-road gas mileage. And an extra foot when the pedal work gets fast and furious. **Stronger suspension.** Front axle rating for the big V-8 is a tough 2500 lbs. And that's tacked on to a frame bred from INTERNATIONAL's big trucks. So you know it's strong. An improved rear suspension civilizes the ride, and new frame mounts veto vibrations.

There's more. As one editor summed it up: "If you haven't driven a SCOUT since its early four-banger days—you won't believe it's the same rig!"

That's the SCOUT 800A. See it—test drive it—at your INTERNATIONAL dealer's. It'll drive you wild. You can quote us on that.



The Scout.

"Scout is the hill-climbingest rascal I've ever driven!"



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THE SKILLFUL DRIVER

If You Meet a Sleeping Driver

To come face to face with a sleeping driver is a hazard in the best circumstances. If you meet him on a two-lane country road, mostly across the white line and into your lane, just as you are rounding a curve, you are in real trouble. If both cars are running at top legal speed, and you have a deep ditch or a drop in place of a shoulder, you can be close to catastrophe. Don't consider going around this guy on the left. There may be traffic behind him, hidden from your view, and you would be risking a head-on crash with a third car. Do everything you can to wake the sleeping driver. Turn headlights on high beam, and blow your horn without interruption. At the same time, brake hard and steer to your right—as far out on the shoulder as you can.

If the other driver wakes up, he is likely to make an abrupt right turn. If he doesn't wake up, your best bet is to slow down and run off the road. If you can lose enough speed first, your car won't plunge into the ravine.

This Sea-Horse 25-hp wins a lot of praise where dependability and operating economy rank high. Whether you're looking for sea food or sea fun, this is the motor to have in a pinch.

In the midst of all this excitement, there's one large bore.

It's the carburetor with a fast feed design augmented by stainless steel reed valves.

Start here with easy pulling manual starting. Accessory electric starting kit available.

If smooth, quiet, float-boating is your game, more power to you with this Sea-Horse 25. Slim, flutter-free piston rings and a counter-weighted crankshaft take all the shout and shimmy out of pontoon power. You'll never lose your cool or spill your cola with this old smoothie on board.

Grab it here and by the handle in front. Now lift. 25 horses at only 3¼ lbs. per horse! You can easily carry it from car to boat. And once on the water, you can leave the lifting to those 25 lightweight horses.

This outboard is a moderately-priced introduction to the fun of water skiing. It can go all out, all day with someone hanging on behind. Tomorrow, it'll be ready to go again, if you are.

Like all Johnson outboards from 115-hp to 1½-hp, the Sea-Horse 25 carries this exclusive 2-year warranty: For 24 months after purchase, Johnson Motors will replace or repair without cost to the original purchaser any part of its manufacture which, upon inspection, proves to have failed in normal pleasure use due to faulty material or workmanship.

Snorkelers will fog their face masks over the way this Johnson jets them to the scene. Once underwater, a peek at the lower unit tells why. It's hydro-dynamically designed to minimize turbulence and drag forces.

Fishermen are lured by the 25's combination of quick delivery, tireless trolling and a high performance prop that runs surprisingly weed-free. It's the greatest thing to happen to fishing since the self-opening beer can.

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Science Newsfront

Last-minute news
and notes to keep you
up-to-date

By ARTHUR FISHER



Rolling wind tunnel—a heavily instrumented station wagon—gathers preliminary data on missile design without tying up conventional wind tunnels at Lockheed Missiles & Space Co. Here a researcher prepares missile model for a fast—but subsonic—run.

An ultrasensitive magnetometer may help predict earthquakes. Developed by scientists in the Commerce Department and at the Joint Institute for Laboratory Astrophysics at Boulder, Colo., the new instrument is ten times more accurate than the most sensitive ones now in use. This means it will be able to detect the minute changes in the Earth's magnetic field that some geologists believe must accompany the buildup of stresses in the Earth's crust that presages a quake. Some experts, though not all by a long shot, think such devices may give enough advance warning to evacuate people before they become victims.

Saturn's rings—some of the most awesome and puzzling objects in our solar system—are made principally of ammonia ice. That's the conclusion reached by Dr. Gerard P. Kuiper and his colleagues at the Lunar and Planetary Laboratory of the University of Arizona, after studying the pattern of infrared radiation the rings absorbed. The temperature of the giant rings is just 75 °C above absolute zero. The inner satellites of Saturn seem also to be made of ammonia ice. Said Dr. Kuiper, "It came as a surprise to me."

A new family of TV-type remote controls will stem from a radically different solid-state device announced by RCA. It com-

bines piezoelectric and ferroelectric effects in a sandwich of two ceramic wafers bonded together with epoxy. Its properties allow the tiny component to turn on, turn off, or smoothly vary the current flow in any circuit—electronically—and to remember its last setting indefinitely, even if power to the circuit is cut off. It will control remote appliances, heating systems, lamps, and tools either with or without being wired to them, and can be used, for example, to give a power tool a smooth, continuous speed control, or to dim a light in another room.

Electronic pinpointing of vehicles in any desired area will aid crimefighters soon. Hazeltine Corporation's new automatic vehicle monitoring system can locate transponder-equipped police cars—10,000 of them in ten seconds, if need be—by means of an electronic "roll call," a series of coded pulses broadcast on the L-band by a base station. Automatically triggered answering signals from the cars are monitored by fixed stations that translate signal time delays into distances. Car 54, we know where you are!

The Tektite I undersea mission proved that scientists can live and work below the sea "for periods limited only by their own desires," according to J. B. Tenney, Jr., an oceanologist at GE's Oceans

Systems Programs. Recent analysis of data from Tektite showed the success of a two-gas (oxygen and nitrogen) breathing system in opening the ocean floor not only to trained swimmers and divers, but to working scientists of no great physical prowess.

One of the moon rocks returned to Earth by the Apollo 11 astronauts shows that its resting place, the Sea of Tranquility, has been far from tranquil in the past. It bore a tiny spherule with a glassy cast. Under the 6,600X magnification of a scanning electron microscope, the spherule, pictured here, appeared to have melted and then refrozen into its present shape. Scientists at the General Electric Research and Development



Center in Schenectady, N.Y. (who found the spherule), and at the University of California at Berkeley, speculated that it had been created when a meteorite crashed into the moon, melting and splattering part of the lunar surface.

A gasoline additive to cut emission of hydrocarbons? The Standard Oil Company of California says yes, and is adding the stuff, called F-130, to its Chevron gasoline. The new additive has been under development for 15 years, and has been put through its paces on the highways, according to the oil company. Standard claims a significant reduction of hydrocarbons in exhaust fumes, increased mileage, and cleaner engines.



Clamshell electron beam welder, largest ever built, derives heat from high-velocity electron flow. Grumman will use it to weld titanium for Navy's new F-14A fighter.

Caprice by Chevrolet.

We don't make expensive cars. But we worry people who do.

With the very notable exception of its price tag, Caprice is amazingly similar to those expensive luxury cars.

If you're even a little bit dubious, please read on.

4,000 pounds of luxury.

First off, Caprice is almost two solid tons of automobile. So you get a nice secure feeling just sitting in it.

It boasts a finely crafted Body by Fisher and spans 18 feet in length.

And has 18 cubic feet of trunk space, too. (Separated from you by our cargo-guard luggage compartment bulkhead.)

Inside, there's comfort in depth. Around 2,000 cubic inches of foam padding to help you sit soft on Chevrolet's most luxurious fabrics.

Caprice isn't big just for the sake of being big, though. You have to sit in it to know what we mean but, well, it just plain feels right.

Computer-smoothed ride.

Of course, a large share of that feeling is derived from Caprice's Full Coil suspension.

We even have a computer select the right springs just for your car, according to the front and rear weight after you've added on whatever equipment you want. No overspringing. No underspringing.

The way we do it is highly technical. The way it feels is out and out plush.

A long, long list of extras.

This is a whole ad in itself, but suffice it to say that Caprice has a longer list of available equipment and custom features than any other car made in America.

Things like our headlight delay system, AM/FM stereo radio with hidden antenna, electric power door lock system, and Comfortilt steering wheel.

A rule of thumb: if it's available, it's most likely available on Caprice.

It moves with authority.

Caprice's standard V8 engine is a highly unstandard 350 cubic inches with 250 horsepower. That's a lot of authority.

Yet it's humble enough to run on regular fuel.

There's also a 400-cubic-inch Turbo-Fire V8 available if you want more torque and more power. It, too, runs on regular fuel.

Still, if you wish, you can order up to 454 cubic inches of engine, the most available in Caprice's field.

Riding in a Caprice is quite a moving experience.

Result: higher resale value.

It's impossible to predict the future, of course, but chances are your 1970 Caprice will be worth more than its competition when trade-in time rolls around.

One reason we can say that is all the reasons you've already read.

The other reason is experience. Chevrolet has a traditionally higher resale value than any other car in its field.

Stop in at your Chevrolet dealer's and mull over a Caprice. Then ask yourself: why buy a car as expensive as this one looks?



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Caprice. You don't leave the comforts of home home.





How \$9.50 buys you more of the life you enjoy most.

Camping is part of your way of life. You have your own rig and you use it to get away whenever you can. To DX, this makes you kind of special. You need and deserve extra services that people who aren't campers never even think about. So DX has created the Trail Boss Club. It's our way of providing you these 7 valuable services—and savings on them—for just \$9.50.

1. \$10.00 in Camping Discount Coupons. Each coupon is worth a dollar off the regular price of a night's camping at Safari Camps—the country's fastest growing chain of luxury campgrounds.

2. Woodall's 1970 Campground Guide. It sells for \$3.95 and is included in your DX Trail Boss Club membership.

3. DX Map Kit. Features regional maps covering the entire U.S., plus a map for each DX state and adjoining states—17 maps in all—all in an attractive zippered vinyl container.

4. Unlimited Trip Planning Service. Tell us where you want to go—we'll provide maps showing campsites and best routes, plus guides for your sight-seeing pleasure.

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6. Invitations to TWO 1970 Trail Boss Club Rallies. Meet other Trail Bosses and share the fun of camping at special campsites in the Midwest.

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Sign on today. This coupon and \$9.50 will bring your membership kit by return mail. If you'd like more information on the Trail Boss Club, ask your DX dealer for literature or write to us at the address on the coupon.



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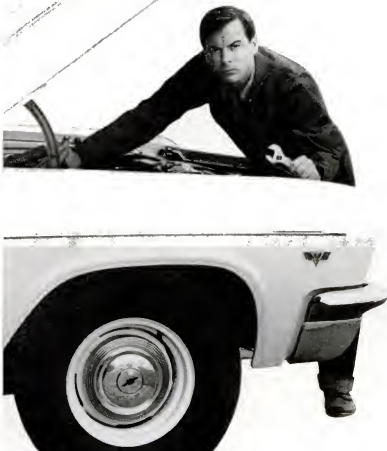
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"Say, Smokey—"

A clinic on cars by America's most famous mechanic

Each month in **POPULAR SCIENCE Smokey Yunick** answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please print your name and address.

I purchased a 1969 Chevy Townsman Station Wagon new last Summer. After 3,000-4,000 miles, I began to feel a sort of jerking in the steering wheel. The dealer couldn't find anything wrong. When I also began to be thrown from right to left on bad roads I decided to try to locate the play. I found it at the ball or taper joint where the pitman arm connects to the control arm, but the play is still there and I'm still thrown all over the road.

N. J. CAMPAGNANO, Southington, Conn.

Your story doesn't give me enough information to even venture a guess, but I think you must have a very serious and dangerous condition with that car. It should be fixed at the dealer level, but since that's failed, I'd say you should take it higher. Write a cabu, sensible, descriptive letter about the problem to the Chief Engineer, Chevrolet Engineering Center, Warren, Mich. I am sure he will turn it over to the proper person and you'll get your car fixed right, and quickly, as well.

Perhaps you can settle an argument. My friend says that the 1969 Indianapolis 500 cars run on pump gas. I say that they run on 10 percent nitro fuel. Who's right?

PETER BURKE, Palo Alto, Calif.

Neither one of you is right. The '69 Indy racers used either straight methanol or methanol with a percentage of nitro. Other years, some used gasoline—but that was a while back.

Do you answer questions from girls, too? I'm saving my money to buy a car, as I will soon be 16. I would like to know if I can get a good car, with good mileage, not requiring costly repair bills, for about \$300. What kind do you suggest? (Miss) C. B. DILE, Indianapolis.

You won't get much today for \$300. Why not wait a while longer, until you have about \$600 to \$800? You can get something fairly dependable in that range. But if you're not willing to wait, then maybe you can luck out by looking for a small car (not foreign make) with six cylinders, and standard transmission, such as a Falcon, Valiant, Chevy II, or

Rambler. Your best transportation buy will be something very few people want: a low-powered car without any of the fancy extras.

My '67 Olds Delta, with 29,000 easy miles, tends to wander. The steering system was checked over twice, the tires have been trued and balanced. Ball joints have .090- and .100-inch clearance. The Olds Service Manager says that this is in tolerance. He says that the ball joints are spring-loaded and therefore the car will never track accurately, and that the only way to get good tracking is to install solid-type ball joints. Does this sound reasonable to you?

ED HOPKINS, Arvado, Colo.

Your wandering Olds could be out of line: front, rear, or both ends. Or, it could have some loose, bent, or worn parts. Be certain, also, that you're not having a tire problem. Check that all shocks are in good shape, too. You shouldn't have trouble with original-equipment parts within proper wear tolerance. I think your problem will turn out to be a 'roll steer,' or 'toe change.' This is a condition where, although you are holding the steering wheel steady, the car rolls and goes up and down, which changes the toe-in and toe-out, essentially steering the car from left to right, even though the steering wheel doesn't move.

I have a '69 Dodge Dart Custom six with 225-cubic-inch displacement. As I plan to honeymoon next August in the Grand Canyon and similar locations I want to have an air conditioner installed. But, I've been told that my car doesn't have sufficient horsepower to carry A/C. Can you offer a solution?

WM. C. REDHEFFER, Blackwood, N.J.

You are short of horsepower, but the air conditioner will only pull power while being used. So you have three choices: 1) Be hot and uncomfortable. 2) Trade for a more powerful car. 3) Put A/C in your Dart and have a cool honeymoon while going five mph slower and burning a little more gas.

What is involved in changing from regular to metallic brake linings on a '68

Chevrolet Impala? I know that new linings and brake-return springs are needed, but is it necessary to have special brake drums, or will the old ones, after being turned or trued up, work okay? My local Chevy man said new drums were required, but J. C. Whitney Co., in their ads for metallic linings, don't mention special drums. What's the true story?

WILLIAM H. DAVIS, Richmond, Va.

You may be getting into something. Metallic linings as a rule, unless engineered to the job, are erratic when cold. But assuming you have that angle covered, all you need are linings and the correct finish on your standard brake drums. Metallic linings need a very smooth surface to work against, and the drum and shoe diameter must be the same.

I have a 1964 Corvette with the 327 engine. It loses about a quart of water a day somewhere in the engine, and there's a jelly-like substance inside of the oil-filler tube. Have you any suggestion on what can be wrong?

RICKY ARMPFIELD, Greensboro, N.C.

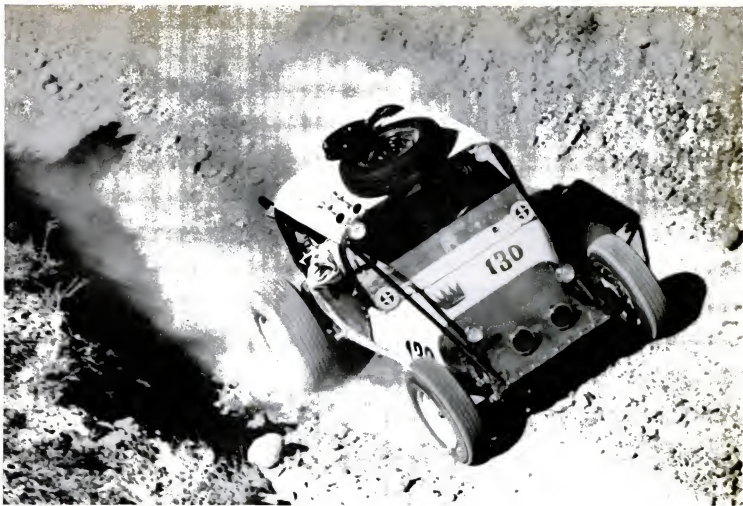
You had better have that engine checked for leaky head gaskets, and check the pressure cap for proper seal and pressure, as well.

Opinion seems to vary widely about two-barrel versus four-barrel carburetors. I am still left with unanswered questions about gas economy. Take two identical cars, except that one has a two-barrel and the other a four-barrel carb. Does the quad setup have to burn more fuel? Granted—at full throttle the gas really gets sucked up by the quad, but I'm talking about steady turnpike speed when it is feeding only from the primary side. I've even heard that some fours may offer a better mileage potential due to a smaller primary venturi and jets than the deuce offered on the same engine in many cases. I'm in the market for new wheels now and want the best of both worlds—reasonable fuel economy but a good power reserve, too. Please advise me what to do.

J. ROGER NYSTROM, Lombard, Ill.

There is no hard and fast rule as to which is champ on mileage row—deuces or quads. Generally speaking, the two-barrel carb is the most thrifty, mostly because the area is smaller and the gas velocity is higher, making for better distribution, especially at lower rpm. The manifold with the deuce is particularly mileage-conscious, for as a rule it is hotter by design. Also the two-barrel manifold is usually smaller in runner area, thus further increasing gas velocity. Four-barrel manifolds are usually more power-oriented, and therefore even the primary side wouldn't have the best manifold for economy.

Got a question on autos? Send it to: "Say, Smokey—" **POPULAR SCIENCE** 355 Lexington Ave., New York, N.Y. 10017 Not every question may be used. Questions cannot be answered by individual letters.



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Keep your engine running clean. Insist on AC Air and Oil Filters—the ones that beat the Baja.

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MARK OF EXCELLENCE



Buick Estate Wagon (foreground) is backed up by Mercury Colony Park (center) and Chrysler Town & Country. Inset: Dodge Monaco



By JAN P. NORBYE
PS Automotive Editor
and JIM DUNNE
PS Detroit Editor
PHOTOS BY TOM FORNANDER

The Deluxe Wagons: Biggest (and best?) in the world

The most expensive wagons have a lot to offer, but are they worth the money? Some of our findings will surprise you

You know it's news when Buick adds a big wagon to its model lineup. The Estate Wagon is back, after an absence of six years—from 1964 through 1969 all Buick wagons were built on the intermediate chassis.

What kind of wagon is the new big one? It can be compared with Chrysler, Dodge, and Mercury in both size and price. These are America's deluxe wagons, with plush interiors, vast roominess, and an almost endless array of options designed to make owning and using the wagons more comfortable and more convenient.

Still, they are not free of some of the same problems that bother us in other wagons. One of the worst is rear visibility. Because the rear window is so far aft of the mirror, you get a kind of tunnel vision. Bigger mirrors might work better, and extra outside mirrors

help. In poor weather, the side windows in the rear tend to fog up, which aggravates the situation. Rear-window defrosters are optional, and highly recommended, but they do not work on the side windows.

All the wagons have tailgates that can be opened both ways—door/plat-

form. But the Mercury stands alone in enabling you to open the tailgate as a door with the glass up—a big advantage on rainy days.

Only the Chrysler and Dodge offer rear-window wiper/washers (optional). Our test Chrysler did not have this option, and on the Dodge.

Continued



Rear-facing third seat in Buick (left) gives excellent leg room for two adults, while

two facing seats in Mercury (right) provide cramped seating for grownups.

Glutton.

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Chrysler's cargo platform (rear seat down) is 95" long, 48.5" wide, with 32" free height.



Door-type tailgate provides for easy loading and unloading of the Dodge wagon.



All doors swing wide open to show the wagon's enormous room and practicality.



Plastic cover for spare wheel of Buick has convenient handle for proper fastening. Removing the wheel is simple and quick.



Easiest back-seat release mechanism was found on Mercury. It's a simple pushbutton you can reach when standing outside.

which did, it failed. Fortunately the Dodge and Chrysler built-in air-deflectors do a very good job of keeping the rear window clean under even the worst conditions.

Buick says the Estate Wagon was engineered as a wagon from the ground up—it's not just a passenger-car chassis with a wagon body slapped down on top of it. We looked into this, and it's true.

For instance, the Estate Wagon has its own rear suspension, not shared with any other model. More, the rear coil springs are 60 percent stronger than the Electra's. They are tough springs, but they do not spoil the ride comfort.

For comparison, the difference in rear-spring rates for Mercury sedans and wagons is only 25 percent, and on the sedans and wagons from Chrysler Corporation, it's 30 percent.

The Buick's long wheelbase keeps its front and rear overhang within reason, and you can carry quite heavy loads in the back without upsetting the handling. In our handling tests, the Buick showed clear superiority over its rivals.

The Mercury has two facing rear seats; all the others have rear-facing third seats. With two facing seats, the under-the-floor storage compartment is lost. On the GM wagon, it's short and wide: 12 inches high by 47 wide by 15 long. The Chrysler Corp. wagons have a long and narrow box: 15 inches high by 28 wide by 34 long. Chrysler Corp. also gives the biggest load area behind the rear seat. Here are the dimensions:

	BUICK CHRYSLER MERCURY & DODGE	
Width	48"	48.5"
Height	31"	32"
Length	58"	60"

When the rear seat is folded down, platform length goes to 91 inches in the Buick, 95 in Dodge and Chrysler and 84.5 in the Mercury.

The Buick Estate Wagon. This wagon seats eight persons with ease; nine in a pinch. Buick's special front suspension geometry, which provides positive camber when a wheel hits a bump, is called Accu-Drive [PS, Oct '68]. It offers a real driving benefit keeping the car stable regardless of side winds and road camber. It's a definite safety feature, and helps prevent driver fatigue on long trips. In addition, the Estate Wagon has fast variable-ratio power steering, making this really hefty bus handle like a Z/28 Camaro.

It also has a sturdy big-car ride and is very quiet. The body has a very solid feel. But what impressed us most of all about this wagon was the brakes. It has the best brakes of any big car we have ever tested. It has

Continued

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It's not just idle conversation.

Lark's Gas-Trap filter is unique. It reduces "tar," nicotine and gas.

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In brake test, Chrysler had problem with unstable under hard braking. We tested premature rear-wheel locking, making car wagons, like sedans, without load in back.



Buick set record for short stopping distance for full-size cars: from 60 mph in 128 feet, four inches after 10 warmup stops. You see nose dive; there's no rear-wheel locking.



PS test equipment includes a Tapley meter (upper photo), which measures deceleration in percent of one g (32 ft./sec.²). Below: the Weston electric speedometer, driven from our Tracktest fifth wheel.

shorter stopping distance from 60 mph than many small cars! The big disks were not fade-free, as pedal pressure rose during warmup, but there was never any shortage of stopping power.

All the controls (except the wiper switch) are well positioned. The instrument panel is well laid out (see photo) and includes an enormous ashtray and a generous glove box.

The Buick has a modern ventilation system without vent windows in the doors (the other wagons still have vent windows), a feature that has proved, also, to be a theft deterrent.

Putting the radio antenna inside the laminated windshield glass also prevents vandalism. Under the hood, the worst thing that we could find was the oil-filter position. The air conditioner does not get in the way of maintenance work, but some of the plugs can be tricky to remove because of their location and the angle at which they're inserted.

Chrysler Town & Country. Look at the Chrysler and the big Dodge for Detroit's biggest passenger-car-based wagons. If you want anything bigger, you'll be looking at Travelalls and

Continued

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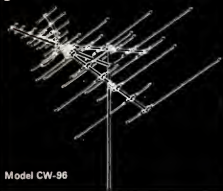
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Model CW-96

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The unique "wedge" design provides a greatly increased vertical capture area, and in a much shorter, more compact antenna. This means your TV set receives increased signal for sharper clearer reception—even on those weak, hard-to-get channels. And it means ghosts, snow and other TV interferences are drastically reduced.

A special truss construction helps make the Winegard Color Wedge the strongest antenna around. It's permanently weather-protected by the genuine gold anodized finish. And the TV wire connections are protected by the exclusive built-in cartridge housing.

Naturally, a Winegard Color Wedge antenna is powerful enough to operate two, three and even four TV sets at the same time. And that's where everything else Winegard makes comes in. We have a new 4-outlet coaxial cable Home TV System (we call it the HSO-782) that enables you to plug all your sets directly into the antenna, and in any room in your house.

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	30 mph smooth road
BUICK	61A/76B/94C
CHRYSLER	62A/78B/94C
DODGE	62A/80B/96C
MERCURY	60A/77B/94C

60 mph smooth road	30 mph rough road
73A/84B/96C	68A/86B/104C
75A/87B/98C	75A/91B/109C
75A/88B/102C	77A/94B/110C
70A/82B/97C	69A/78B/106C

other wagons based on pickup-truck chassis, or those small buses [PS, Sept '69]. The Chrysler has a tough feel, and its power and performance are nothing short of amazing.

Inside, the door trim, seat padding, head liner, and floor covering consisted of unmatched shades of green. The head liner was made of a hard-surface, perforated plastic material—probably great for acoustics—its joints covered by chrome-plated plastic. We like the floodlighting of the instruments.

The controls are not always easy to work. The brake release, for instance, is only four inches higher than the parking-brake pedal! The "flower

boxes" along the rear side windows are handy storage compartments for passengers. We could not get the plastic spare-wheel cover that's part of the same structure to fit.

Under-hood accessibility is poor. The spark plugs are hidden under the exhaust manifolds. They are hard to reach, and there's always a risk of burns. The oil filter is boxed in, and hard to get at even from below.

The Dodge Monaco. Dodge shares the basic body with Chrysler, and in this case uses the same running gear. Much of what we said about Chrysler applies also to the Dodge. We found the same astounding power and the same ample interior space.

Both wagons have unit-construction bodies which tend to carry noise and vibration far more than bodies mounted on separate frames. The Dodge body had a tight feel, but road noise at high speed was disturbingly high.

The instruments are illuminated from behind. The recessed rocker switches for lights, rear window, and front and rear window washers are difficult to operate and very hard to find in the dark. The split-bench front seat with individual armrests proved comfortable.

Mercury Colony Park. The most luxurious and best-appointed interior I found in this wagon. The upholstery looks and feels just like leather. We were impressed by the quietness of the vehicle. There's great head and leg room in the back seat, but the two facing third seats offer less room for adults than the rear-facing third seats in the other wagons. Both rear seat and third seats are simple, light and easy to fold and erect. The push button release for the rear-seat back makes for extra convenience.

The tailgate can be opened (as door) with the glass up (a Ford Mercury exclusive). A backlite a

Continued



Windshield wipers on Mercury lack the clever articulation used on other cars and leave a big triangle of unwiped area next to the corner post at driver's side.



Buick instrument panel is neatly arranged in front of the driver, and all controls (except wiper and washer) come easily to hand. A/C outlets, too, are well placed.

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deflector, however, is an extra-cost option. There is no low step in the rear bumper, as on GM wagons.

The intermittent wiper action is an important plus point. The only instrument, in addition to speedometer and odometer, is a gas gauge. The rest are idiot lights.

Underhood accessibility turned out to be a pleasant surprise: You can get at almost everything very easily. The distributor is right in front, the plugs are in the open, the air conditioner is out of the way, and the oil filter is easily changed from below.

Strangely, we had several failures

in this wagon: First, a short circuit in the brake lights. Next, complete power-steering failure (due to a leaking gasket). Finally, the starter went dead. It turned out to be a short circuit inside the steering column.

Conclusions:

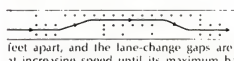
Dunne: I'll take the Buick. It's just more wagon in every way, and I always feel safe with those brakes. It's got plenty of power, and great economy, too.

Norbye: Yes, it has to be the Buick. It's a wagon I really enjoy driving with that quick steering response and those wonderful brakes.

How PS tests cars—and what the tests show

Our brake test shows a car's ability to stop in a straight line from 60 mph, without locking any wheels, after 10 stops from 60 mph at one-minute intervals with 1/2g deceleration (normal quick stop.) The final stop is made in a 12-foot-wide lane and stopping distance is measured. Excessive pedal pressure indicates fading brakes. Excessive distance indicates fade, locking, or both in combination.

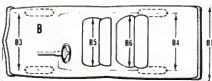
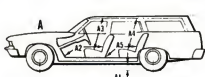
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DIMENSIONS (inches)

A1 Ground clearance	7.5
A2 Front leg room (max.)	42.2
A3 Front head room	37.6
A4 Rear head room	38.9
A5 Rear leg room (min.)	39.6
A6 Wheelbase	124.0
A7 Height	56.4
B1 Width	79.5
B2 Length	222.5
B3 Front track	63.4
B4 Rear track	64.0
B5 Front hip room	63.4
B6 Rear hip room	62.6

SPECIFICATIONS

Engine type	OHV V-8
Bore x stroke	4.3125 x 3.40 in.
Displacement	455 cu. in.
Compression ratio	10.0:1
Carburetion	One 4-barrel
Power @ rpm	370 @ 4,600
Torque (lbs.-ft.) @ rpm	510 @ 2,800
Transmission	Turbo H-Matic
Axle ratio	2.78:1
Tires	F. Goodrich
Tire size	L78-15
Turning diameter	42.2 ft.
Turns, lock to lock	3.3
Brakes	Disk/drum
Fuel tank	24 gal.
Curb weight	4,862 lbs.

TEST RESULTS

Acceleration 0-60 mph	9.7 sec.
Acceleration 0-80 mph	17.7 sec.
Acceleration 25-70 mph	10.8 sec.
Braking distance 60-0 mph	128 ft. 4 in.
Brake-pedal pressure	120 lbs.
Max. speed—lane change	42.2 mph.
Max. speed—tight weave	23.25 mph.
Average fuel mileage	10.8 mpg.
Price (basic)	\$4,738
Price (as tested)	\$6,688

CHRYSLER

Town & Country	9.5
	41.8
	39.6
	40.1
	39.6
	122.0
	58.1
	79.5
	225.4
	62.1
	63.4
	63.3
	63.3

OHV V-8

4.32 x 3.75 in.	440 cu. in.	9.7:1	One 4-barrel	350 @ 4,400	480 @ 2,800	Torque Flite	2.63:1	Goodyear	J78-15	44.9 ft.	3.3	Disk/drum	23 gal.	4,710 lbs.
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DODGE

Monaco Wagon	5.8
	41.8
	39.6
	40.1
	39.6
	122.0
	58.3
	79.2
	223.6
	62.1
	63.4
	63.2
	63.3

OHV V-8

4.32 x 3.75 in.	440 cu. in.	9.7:1	One 4-barrel	350 @ 4,400	480 @ 2,800	Torque Flite	2.63:1	Goodyear	J78-15	44.9 ft.	3.3	Disk/drum	23 gal.	4,696 lbs.
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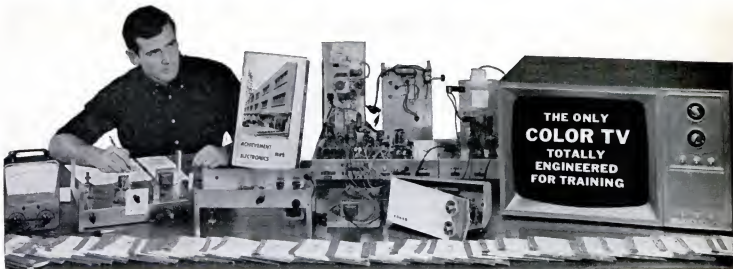
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Colony Park	5.5
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	39.1
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	37.1
	121.0
	56.8
	79.2
	220.5
	63.0
	64.0
	62.2
	62.3

OHV V-8

4.36 x 3.59 in.	429 cu. in.	10.5:1	One 4-barrel	360 @ 4,600	480 @ 2,800	Select Shift	2.78:1	General B.	H78-15	42.2 ft.	4.0	Disk/drum	23 gal.	4,751 lbs.
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By ERIK H. ARCTANDER PHOTOS BY JACQUES BERLOT

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There they squatted, pudgy little trunts with half-a-dozen doughnut tires. Cute as teddy bears, yes, but the most improbable-looking bush buggies you've ever come across.

The scene: a rugged New Hampshire mountainside near Lake Winnepesaukee. Nineteen all-terrain vehicles were lined up in single file, straining to launch themselves onto a 17-mile obstacle course laid out through dense woods, mud, streams, and boulders.

This was the first major ATV race anywhere and I was here to observe, then solo. I climbed into a 12-hp AtTex next to "Dutch" Shultz, an American Airlines flight engineer who was introduced as "an experienced ATV race driver." No one warned me that the competitive urge glows especially bright in Schultz's breast—but I quickly found out.

All ahead flank. When the starter waved us off, Dutch changed the engine's docile "pop-pop-pop" into a snarl and jammed both vertical control sticks forward. We leaped ahead, rumbled several hundred yards across a flat stretch of grass, and turned into a steep ravine. Charging full-bore down one side set my adrenalin flowing, which soon proved useful. We were slowed to a crawl by mud and rocks at the bottom and stalled two-thirds of the way up the other side. Our 12-hp model lacked the moxie; more powerful ATVs, we learned later, had zoomed up nonstop.

I offered to abandon ship and lighten the load, but Dutch shook his head. He turned the ATV to go down and start over. As we got crosswise on the hill, our beamy buggy rolled over sideways. I leaped off the low side and landed safely on my feet; Dutch somehow bailed out on the high side and held it upright. We wrestled the vehicle around and Dutch made a second climb successfully—while I walked up.

Press on, regardless. Once clear of the ravine, Dutch took off up a twisty fire trail like a man with suicidal tendencies. I held on grimly, one hand clutching the front edge of the seat, the other the rubber bumper strip around the side.

For the next 45 minutes we roared through the woods at speeds of up to 30 mph. Schultz handled the little beast like a light tank, jiggling the two sticks to slow one set of wheels or the other. He kept the throttle wide open, swerving only to avoid trees, boulders, and big holes.

My pathfinding instincts—developed in motorcycle enduro riding—were all wrong for an ATV. Dutch charged through mud, slippery stream beds, loose gravel, and piles of wet leaves that made me wince. Go around

You're looking at something you've never seen before.



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APACHE

best looking camper you ever saw. And get this: Prices start as low as \$1095 (plus freight). That's right, \$1095.

In fact, some of our models are actually priced lower than last year's. Two models and four floor plans for you to choose from. Apache's new Solid-State Camper. See the Yellow Pages for your nearest dealer or write the Vesely Company, Box 401, Lapeer, Michigan 48446.

**VESELY
COMPANY**





Scrambling over rocks, wet or dry, barely slows an experienced driver; but I crossed this gully cautiously. With six powered wheels, the Attex always finds some traction.

On a very steep hill, you can walk alongside the ATV and control it from outside.



Sure it jumps! Gun it up a rise and take off over the crest—the landing's soft.



ATVs are so light that leaning makes a difference. Center-mounted controls make solo driving the most comfortable, but there's room on the front seat for two.



tree limbs, chuck holes, rocks? What for? These floppy tires just flowed over obstacles as though someone were laying down mattresses ahead of us.

Once we hurtled into a tight corner and slammed head-on into a small tree. The remarkable tires just sat there and soaked up most of the shock while the body recoiled. A 15-mph crash that would have disabled a motorcycle and rider only jolted us and put a 10-inch-split in the ABS plastic body.

Later we clambered over a jumble of waist-high boulders that would have balked a mountain goat. But no matter what crazy angle we assumed, the Attex always found a grip for some of its six wheels. By now I was a believer—these chubby rascals really can go just about anywhere.

We came in fourth, despite the small engine, and all but three others finished. Two had broken axles, one ran out of gas. A remarkable performance.

Our turn to drive. Next morning, after the aches had subsided and before other ATVs could clutter the landscape, I climbed into the same Attex we had raced the day before; it, too, had been serviced. I turned a key and fired up the engine. This one has a starter—a worthwhile accessory for any size machine.

Grasping the two control sticks, I gently squeezed the throttle on the right-hand one and shoved both sticks forward. The automatic clutch took hold and we lurched ahead—straight for a tree. I fervently wished for a steering wheel in place of these ridiculous levers.

A frantic pull back on the left stick spun her sharply that way, lifting the left side abruptly. I let go of the throttle and the ATV plopped down on all six wheels again. This was going to be tougher than I'd expected.

Now I understood why Schultz had jiggled the sticks back and forth quickly, a few inches each way. He'd been making slight but continual course corrections. You don't really steer an ATV—none of the wheels pivot. You make the set of wheels on one side over-run the set on the other side. And that jangles your reflexes.

Bless those weird tires. I took off again, jiggling the two sticks like mad. It worked fine on gentle curves and slight course changes. But when right-angle turns or detours loomed up too fast I fell back on every beginner's standby—shut off the gas. An ATV punishes you for this craven act: it stops dead. There's no gradual rolling to a halt, no free-wheeling. When the Salisbury clutch disengages, those six marshmallows stick

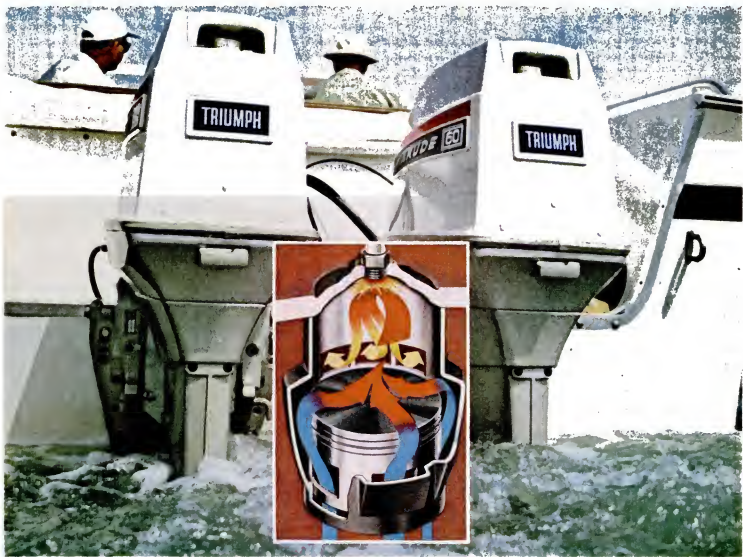
[Continued on page 19]

There's a



new power structure

in the middle power class



Evinrude's loop-charged "60"
leads the power revolution

This is the mid-range motor with the *inside* advantage. The one with efficient, economical, *legitimate* loop charging.

Instead of conventional ports in the cylinder walls, Triumph gets its fuel through *aimed* fuel passages that loop the fuel charge *upward*, from three directions, swirling it *directly into the top* of the combustion chamber.

Piston deflector humps aren't needed

— so the combustion chamber doesn't have to be shaped to accommodate them.

The result is more efficient combustion — more power from less fuel — without overheating the pistons or the engine.

New self-cleaning pressure-backed piston rings add another power bonus — by improving the combustion seal and reducing friction. Power-tuning adds still another. And the computer-

designed lower unit converts maximum power into thrust.

And the final pleasant surprise: The push-button new Triumph "60" is as elegant and quiet as it is efficient and quick and strong.

Just because it leads a revolution doesn't mean it has to look the part.

Write for catalog, Evinrude Motors, 4216 N. 27th St., Milwaukee, Wis. 53216

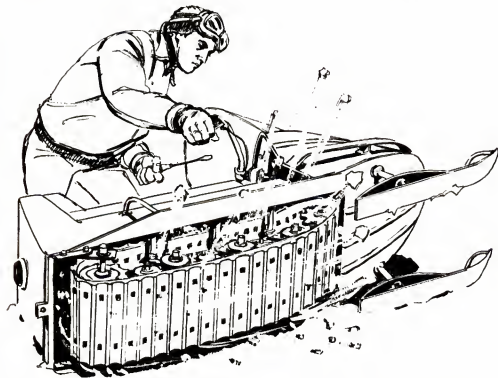
power for the performance generation **EVINRUDE**  **first in outboards**
Div. of Outboard Marine Corporation

6 SNOWMOBILE EMERGENCIES

...and what to do about them

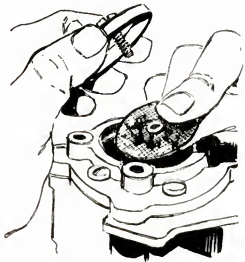
Your snowmobiling fun doesn't have to be ruined by mechanical troubles if you're prepared to cope with them. Here are six of the most com-

mon snowmobile problems you might encounter on the trail, and some handy advice on how to fix them with minimal equipment to get home.



1 Your snowmobile's track may freeze up, especially when you travel over slushy terrain, then park it for a while. Chop away big buildups with a screwdriver. Start the engine. Then turn the machine on its side

(as shown above) and rev it up. This should loosen the track. If not, repeat the process. Bouncing the rear of the snowmobile up and down a few times is enough to loosen less severe freeze-ups.

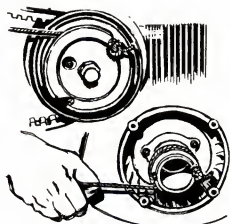


2 A plugged gas filter can kill your engine and leave you stranded. If the engine isn't getting fuel and the tank is not empty, check this trouble spot. Unscrew the gas filter cap and remove the filter. Clean out any debris or film you find on the screen. This should allow gas to flow freely, and you'll be on your way.



3 Rough terrain can sometimes knock the track off its drive sprockets. Carry a small block and tackle with you so that you can hoist the rear end of the vehicle, as shown above. This will allow you to move the track freely and work it back onto the drive sprocket. Make sure the track is centered and that it turns evenly.

4 A hidden rock or tree stump could break the tip of one of your skis and, because it will dig into the ground, prevent you from driving. Hammer the remaining piece upward and secure it with rope, wire, or even a leather belt to keep it from digging in. This should enable you to make it back to where you can replace it.



5 Don't panic if your recoil starter rope pulls out or breaks off. There are other ways to turn your engine over. Remove the manual-start housing to expose the starting pulley (bottom). Wrap a rope or your belt around it and pull hard. If your machine has an emergency starting sheave (top), wind a cord around it and yank away.



6 A broken fuel line is a major headache, but you can fix it with a ball-point pen that has a removable cartridge. Simply thread the ends of the fuel line over the empty pen barrel. Then tie each end around the barrel with wire as tightly as you can. This should hold until you return to base, but replace the fuel line promptly.

BOLENS HUSKYS FOR 1970...



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Your hands never leave the steering wheel! Because one foot pedal controls forward, reverse, and power braking . . . automatically. We call it a hydrostatic transmission. You'll call it wonderful.

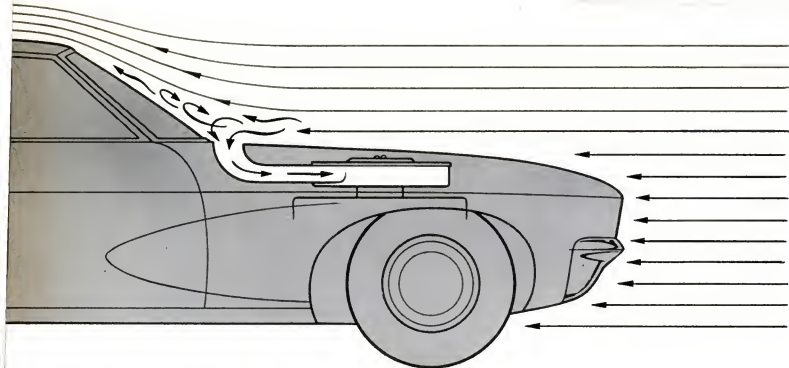
"Big Tractor" ideas put Bolens Huskys in front of the rest of the pack. Look one over and you'll see why. Job-designed features. Time and work-saving conveniences. Rugged construction wherever you look. (After all, they've got a name to live up to . . . Husky.) Eight champions in the Husky breed—from 7 to 14 hp. See them at your helpful Bolens Husky dealer.



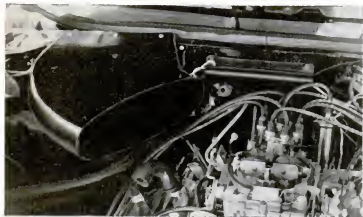
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The Bolens Husky team . . . Compact tractors
• riding and walking power mowers
• tillers • snow blowers • snowmobiles



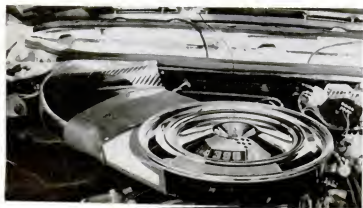
Performance-boosting modification inducts cool air through cowl vents in high-pressure area and feeds it straight into carb.



Buy Camaro Z-28 air duct and locate it on the firewall, in line with your air cleaner. Saber-saw a hole through firewall into the cowl intake plenum chamber, and mount duct over the hole.



Make a sheet-metal duct with the same perimeter as the Camaro duct. Fasten it over enlarged opening in air cleaner by bending back tabs cut in cleaner, then pop rivet. Allow a two-inch clearance between ducts to compensate for normal engine movement.



Pep Up Your Car with Cool Air

Ten percent more power: That's what this simple engine modification can give you

By CLYDE J. BAKER

Ever notice how much better your car seems to run after a cool shower on a hot day? It's because the air is cooler and heavier than before the rain. Your engine is inducting more air by weight, and the effect is the same as an increase in engine displacement.

Here's a modification you can make on your car that will take advantage of this cold-air effect, no matter what the weather. It's a cold-air package, similar to the one on the Camaro Z-28 with high-performance engine. It ducts cool air from outside the engine compartment straight to your carburetor, instead of letting your engine suck up hot air that's been through the radiator. It can increase power up to 10 percent, and helps prevent spark knock.

Unlike the cold-pack systems used on many late-model high-performance cars, this one involves no hood scoops to detract from the lines of your car. It takes in air through the cowl vents. These vents, located in the high-pressure area in front of the windshield, are the ideal place to induct cool air for the engine.

To get started, order a special air duct (part number 3916621) from your Chevy dealer. When it arrives, follow the procedures outlined under the photos; then prepare yourself to answer the questions sure to come when service-station attendants open up the hood.

You get a neat installation with air cleaner reassembled. Use a section of inner tube to connect the ducts. Rivet it to the air-cleaner duct and stretch it over duct mounted on the firewall.

This on-off anti-reverse lever lets you activate the drag action in an instant—or let the line run free.

Ted Williams didn't think a great spin-casting reel had to cost a bundle.

Sears proved it.

This matched Model II fiber glass rod has hundreds of thousands of fibers that run the length of the rod for greater strength, more uniform flex.

When a fish runs, he won't run you out of line. This reel packs 150 yards of 6-lb. test monofilament.

You get positive line retrieve with this reel's head. It's got an 8-point pick up.

There's plenty of fish-fighting power packed inside—smooth running, precision diamond-cut 4 to 1 gears.

This check mark and signature certify that Ted Williams, Chairman of the Sears Sports Advisory Staff, personally tested and approved this Model 240 reel and Model II rod.

Ted Williams
QUALITY

Ted knew there had to be a way to make a great reel—but without making it expensive.

With his help, that's exactly what Sears did with this one.

It's loaded. With features you'd expect only on more expensive reels.

Like the big star drag that lets you set the proper line tension for any size fish. You can do it fast and easy, too, because the drag control's right on the handle—not on the reel housing. And you don't have to worry about a snarled up line. The drag's fixed spool prevents the line from twisting even when you're cranking against a running fish.

Ted and Sears put a lot of other great things on this reel, too—including a price tag of under \$12. You can pay more and still not get as much reel for your money.

Tomorrow, check out this Ted Williams Model 240 reel, and see all the other great spin-casting reels at the Sears Sports Center in a Sears, Roebuck and Co. store. Or look in the Catalog.

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An armada of '70 Chrysler Boats, from runabouts to coho fishers to cruisers, 12 to 24 footers. All BIA certified.

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MARINE PRODUCTS



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Over hill and bog, snow and water in the

Amazing Air Cycle

This \$1,300 ACV flies 40 mph over land, 30 mph over water. The secret: a foam-plastic body, single prop, 25-hp engine

By **ERIK H. ARCTANDER**
PHOTOS BY **CARI HOWARD**

Fascinated, I watched the Air Cycle drone back and forth across a snow-powdered meadow like some out-sized vacuum cleaner. Then it slid up and down a nearby slope, and whirled around in lazy circles.

"Nothing to it," I told myself, as test-pilot Ihor Kasianczuk set the machine down nearby. After all, I'd won my wings on the air scooter, a primitive little air-cushion vehicle you steered by leaning [PS, Jan. '69].

"Sit back to keep her balanced," Ihor (Ee-or) instructed. "Shove the pedal down to close the brakes, grab the throttle lever with your right hand and the steering wheel with your left." He switched on the starter, and up forward a 25-hp two-stroke single coughed itself awake.

I pushed hard on the brake pedal, squeezed the throttle, and the Air Cycle's engine revved up to 4,100. Then we were moving—the inch-and-a-half rise off the ground had been imperceptible. For the first 10 or 15 feet we glided over the grass at a walking pace. Icy blasts whipped through the tunnels on both sides of my legs, a snowy mist spurted out from under the sides, and engine and prop noise thundered in my ears.

Suddenly I was riding a tiger—zooming forward faster and faster. She gobbled up the open field at 30 mph or better. I let up on the brake pedal and turned the wheel hard left. At first nothing happened; then slowly, her head began to swing.

That's when exhilaration turned to panic. In typical ACV fashion, the Air Cycle pivoted on its cushion while sliding bodily in the original direction. Soon we were skidding backward, then sideways as the vehicle spun around its center of gravity. She finally stopped sliding, but kept on spinning in place like a miniature merry-go-round. I cranked the wheel hard right. Rotation slowed, then stopped. I put the wheel amidships—too late—she began swinging the other way.

You learn fast. That first flight, a five-minute fiasco, ended abruptly. I let go of the throttle and landed. It was a coward's way out, but the only alternative to riding an uncontrolled whirligig.

Until better brakes are developed, the Air Cycle with its single propeller for lift and propulsion is an all-or-nothing ACV. Squeeze the throttle and it's up, up, and away. Unlike the two-prop, \$3,500 Revfite [PS, Jan. '69], the Air Cycle I tested can't hover or back up. A reverse-thrust device that is in the works promises to make it hover, however.

Continued



A high thrust-to-weight ratio explains the Air Cycle's amazing performance: It develops 100 pounds of thrust, yet weighs only 250 pounds. The unique ACV will fly a 300-pound payload over almost any nonporous surface at an altitude of 1½ to 1¾ inches.





Multiple strobe-light exposures display the Air Cycle's unusual hill-climbing ability. This grassy slope has a 20-percent grade.



Water, soft earth, or hard concrete—it makes little difference to the ACV's air cushion. Air Cushion Vehicles, Inc., Troy, N.Y. 12180, expects that most of its Air Cycles will be licensed as boats. The flight over a highway, pictured below, was made as a stunt. The vehicle is skimming over a still unopened stretch of new road.



Over the next half-hour I made two more five-minute flights. Each time the ACV behaved more manageably. You catch on: Give her a fast jolt of full rudder, then take it off before she starts to swing. Whip around 180 degrees when you want to stop; then back up until forward thrust overcomes the momentum. Rock the plane into a corkscrew if it hangs up on a hummock or rock. Ease up on the throttle to slow down, but remember that then the cushion is thinner and the rudder vanes have less effect. Finally, don't be ashamed to shut off and set her down, then start over.

Flying on ice and water, Dr. Hugo Ferguson, the Air Cycle's inventor, had invited me up to his factory near Troy, N.Y., for some test flights. (The reel-vortex mower, which we reported on last October, is also a Ferguson device.)

Now, as we headed for ice and open water, I was armed with a wisp of confidence and a diver's wet suit under my regular clothes. Dr. Wylie Childs, Air Cycle's marketing director, drove us first to a frozen lake a quarter-mile long and half that wide. We partly flew, partly wrestled two Air Cycles off trailers and onto the ice. Then I would fly the "chase plane" while I cavorted.

All that open space, flat as the Bonneville salt flats, begged for full throttle. My ACV quickly picked up speed and scooted over the ice at 35 mph or better. By counteracting any swiveling motions the instant they began, I arrowed several straight flights down the center of the lake.

Stops and turns were no trickier on ice than on grass. Setting her down on smooth ice was more exciting. At one point I swung around 180 degrees to stop; she kept flying backward at the shoreline loomed up. Panicky, I set the Air Cycle down six feet from the railroad-tie bulkhead. We were

"Flying the Air Cycle is like sliding too fast on slick ice"

still doing about 15 mph as she slid on slick ice, her starboard quarter thwacking into a tie.

It should have been a severe head-snapper. But the ACV's tough platform of closed-cell plastic foam soaked up most of the shock. The jolt merely lifted my chin a bit, and barely left a mark on the vehicle.

Boating on the Hudson. Next we found a launching site on the ice-fringed river above Albany. Thor flew an Air Cycle down a steep hill to the river, then over a wide border of jagged ice floes to open water. After a few trial runs in midstream, he turned the machine over to me.

"Don't make sharp turns," he warned. "You might catch an edge under a wave and tip over."

Gingerly I flew out onto the river, turned parallel to the shore and opened her up. The ACV just munched along at first, like an underpowered outboard. Suddenly, at roughly 10 mph, she climbed up out of the hole her cushion was making in the water and flew. Slower than over land, her water speed of 25 to 30 mph was still impressive. A swift current made no difference—she flew just as fast in either direction.

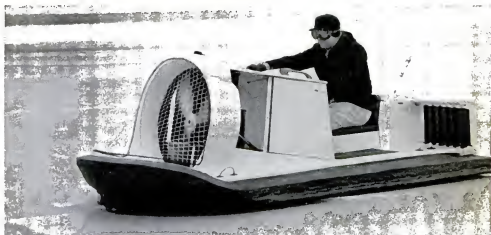
Light spray blew up on both sides, instantly freezing on gloves, jacket, and pants legs. Yet the Air Cycle made a reasonably comfortable boat. When I let her down, the plastic-foam platform floated with only a few inches submerged. Small wonder; it can support 1,000 pounds in water.

Strictly for fun. "The Air Cycle," Dr. Ferguson explained later, "is for fun, not transportation. It will need the kind of elbow room you find mostly on lakes, rivers, and sounds. So we'll include navigation lights fore and aft, a lightweight anchor, fire extinguisher, and a floating cushion as standard equipment."

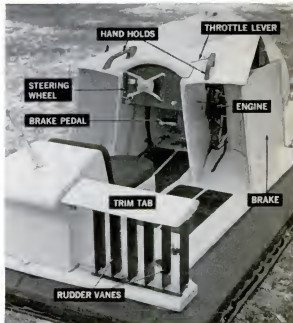
"We're very much concerned about safety," Ferguson emphasized. "You saw how effective the Ethafoam bumper was in a collision. Well, we're developing a prop guard strong enough to fend off anyone who might fall on the front of the vehicle."

"Most important," Ferguson continued, "we won't sell an Air Cycle until it has effective brakes. The experimental ones on your test machine aren't good enough. We're working on a new approach—pedal-operated foils that will use the vehicle's thrust to stop it quickly."

They'll begin turning out the standard 25-hp single-cylinder machine and a higher-performance 33-hp twin this month. The single will sell for \$1,295 and the twin for \$1,495. The line forms behind me.



Test flights on ice and water (top) proved Air Cycle had lots of go, needed more stop. Single aluminum prop on the crankshaft of a 395cc JLO-Rockwell engine (above) blows three-fourths of its airstream backward for thrust, one-fourth downward for lift. Chutes on either side carry 120-mph blasts back through the rudder vanes (right). You adjust the trim tabs to level the craft.



Three stiff brushes serve as landing gear. Also visible: muffler, neoprene skirt.



How APOLLO 13 Will Probe the Moon's Interior

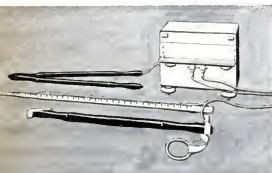
By
**DR. WERNHER
von BRAUN**

From directing NASA's Marshall Space Flight Center at Huntsville, Ala., Dr. von Braun has just gone to Washington as one of NASA's deputy associate administrators. This is one of his frequent articles on space for PS.

ILLUSTRATIONS BY RAY PIOCH



Tapping moon's secrets with battery-powered core drill will be new Apollo 13 adventure. Drilling 10 feet down will get much deeper lunar samples than any yet. Then, one-inch-diameter holes will serve for new "heat-flow experiment" to help settle such disputed questions as whether moon has molten core like the earth's.



Heat-flow experiment with this gear will tell if heat is rising from inside of moon. Two-section probes measure temperature at different levels below the surface.

Crashing a Saturn rocket stage on the moon, and plumbing lunar depths with a key heat-flow experiment, will help our new lunar observatories bare the moon's secrets

When Apollo 13 heads for our third manned lunar landing, next month, it will begin in earnest the intriguing task of exploring the moon's interior. The findings of Apollo 11 and 12, which hardly scratched the surface of the moon, have been so rich that scientists look forward eagerly to learning what is beneath. Coming experiments will tell.

With a new battery-powered core drill, Apollo 13 astronauts will bore two 10-foot-deep holes in the moon. That will bring up samples from far beyond the previous depth limit of about 40 inches—with Apollo 12's hand-coring tubes—where underground strata were getting more and more interesting. (One layer tentatively looked to scientists much like volcanic ash or pumice; and content of carbon, a prerequisite for possible life, was reported apparently increasing with depth.)

And, through a new "heat-flow experiment," the holes will prove an open sesame to what lies far deeper. On probes lowered into them, arrays of sensitive temperature-measuring thermocouples will tell whether heat is flowing outward from the inside of the moon to its surface. Subsurface heat conductivity will be measured, too, with the aid of small electric heaters in the probes. An underground temperature profile deduced from these tests will throw new light on whether the moon, like the earth, has deep, radioactive heat-generating layers and a molten core.

Biggest artificial meteor. An Apollo 13 "spectacular" will be the meteor-like crash on the moon of the great Saturn V rocket's whole top stage and instrument unit, totaling more than 15 tons' weight. Instead of being aimed past the moon as before, the rocket stage will be targeted at a point on the surface about 125 miles from Apollo 12's Ocean of Storms seismometer, which will register vibrations from the impact.

This will be a dramatic scale-up of the Apollo 12 experiment of crashing the empty 2½-ton ascent stage of its Lunar Module on the lunar surface.

The astounding result of that crash: The moon rang like a bell for nearly an hour, indicating some strange and unearthly underground structure. Intended to probe this subsurface formation with stronger and longer-range seismic waves, the impact of the heavier and faster-speeding Saturn stage should really make the moon clang! For good measure, Apollo 13 will also crash its own Lunar Module ascent stage, some 42 miles from a new seismometer that it will have emplaced on the moon's surface.

The landing site. A lunar highland region named Fra Mauro (for a monk and cartographer of early times) has been tentatively selected as Apollo 13's prime landing site. Only about 110 miles east of where Apollo 12 touched down, it offers terrain of far different kind. Scientists picked it because of these characteristics:

- It is an "old" area where soil and rocks are untouched by volcanoes or the ancient lava flows believed to have formed the *mares* (such as Apollo 11's Sea of Tranquility and Apollo 12's Ocean of Storms).

- Suspected in this area are *ejecta*, lunar-soil samples thrown from the depths by meteor impacts, from the Sea of Rains to the north.

- There is a high ridge of interest close to the landing site.

- There are some small bright impact craters that are believed to be of fairly recent origin.

Just in case a continuing study of Apollo 12 high-resolution photographs should reveal any unacceptable features of a Fra Mauro landing, a backup site has been earmarked near the Hyginus Rille, about 25 meridian degrees farther to the right on the moon's disk. It features a rather long linear "rille," or surface fracture, along a chain of small craterlets. Here, volcanic materials and "age dating" would be of primary scientific interest. But, as of this writing, nothing has come to light that would rule against the prime site, and so it looks as if Fra Mauro is "it."

Apollo 13 will be skipped by one

Continued



Spectacular Apollo 13 experiment will be 5,700-mph crash on moon of Saturn V rocket's 15-ton top stage. Seismometer in Ocean

of Storms will register impact. This will be scale-up of 2½-ton Lunar Module ascent-stage crash that made moon ring like bell,

and will explore the underground structure causing the unearthly effect with stronger and longer-range seismic waves.

of NASA's most experienced astronauts, Capt. James A. Lovell, Jr., USN. He was Frank Borman's sidekick in Gemini 7, which in 1965 set a still-uncontested world record of 14 days in orbit; and he was a member of the history-making Apollo 8 crew that orbited the moon on Christmas Eve, 1968. So it can truly be said that "Jim's been around." His travel companions in Apollo 13 will be two space rookies—research pilots Thomas K. Mattingly II, a Navy officer, and Fred W. Haise, Jr., a civilian.

The Apollo 13 backup crew will be made up of Cmdr. John W. Young, USN, skipper, and astronauts John L. Swigert, Jr., and Charles M. Duke.

Fra Mauro is the first Apollo landing site to be selected, not for smoothness and a minimum of hazards, but for scientific "paydirt." Setting the Lunar Module down in really nasty terrain will demand more time for hovering, so that its pilot—like a helicopter pilot—can select a safe landing spot among obstacles.

Had the Apollo 11 and 12 sites been much rougher than they were, or the

crews less well trained, both Apollo 11 and 12 might have had to abort the landing attempt from a very low altitude—simply because they would have used up their small reserve of propellant for hovering, before the pilot could locate and commit himself to a spot smooth enough. As the Lunar Module (LM) rapidly descended through the last 100 feet of altitude, time to select an obstacle-free landing spot was awfully short. The target area came into view about 120 seconds before touchdown, but only the last 20 seconds or so revealed hazardous boulders and small rough-bottomed craters.

New strategy extends hover time. To enable the LM to hover longer, Apollo 13 will use, for the first time, a novel "delta-vee" strategy. In essence, it means that the Command and Service Module (CSM), instead of keeping to a lunar orbit nearly 70 statute miles high, will itself approach to within 10 miles of the moon's surface before the LM separates for a landing.

The velocity-change capability of

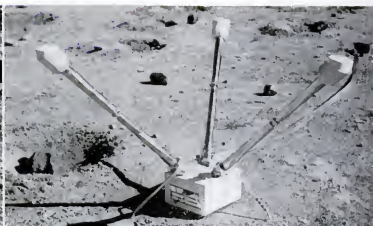
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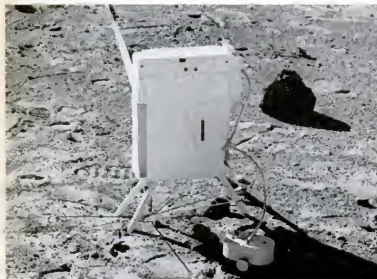
"Central station" holds nuclear-power supply for Apollo 13 moon-observing instruments. Atop it is radio antenna.



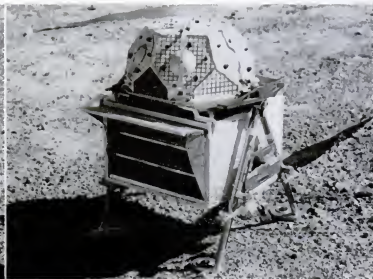
Lunar observatory to be emplaced by Apollo 13 includes drum-shaped seismometer, above, to detect quakes and meteoric impacts. "Thermal shroud" limits temperature fluctuations within.



Magnetic field on moon is recorded by magnetometer, with three sensors at right angles to each other on three-foot booms. Similar Apollo 12 model found site more magnetic than expected.



Lunar-ionosphere detector will observe charged particles near moon. Lunar-atmosphere detector, built into pictured Apollo 12 version, will be separate unit in Apollo 13's instrument package.



Solar-wind spectrometer, to monitor stream of electrons, protons, and other particles bombarding the moon from the sun, completes Bendix-designed package of lunar instruments.

What Is Congress Doing About Safer Products in Your Home?

By
ARTHUR
FISHER

Thirty thousand deaths and 20 million injuries a year! That's not the casualty list from some major war. It's the toll of Americans felled by accidents in and around the home. And a disturbingly large proportion of these accidents, according to the U.S. Public Health Service, is linked to the products we use—and misuse—daily.

Home power tools, for example, account for 100,000 injuries a year. And from four household items alone—power mowers, stoves, heaters, and washing machines—the USPHS lists some quarter of a million injuries a year.

Are these accidents avoidable? If so, what action should be taken, and by whom? These are the questions Congress wanted answered when, in 1967, it created the National Commission on Product Safety to:

“Conduct a comprehensive study and investigation of the scope and adequacy of measures now being employed to protect consumers against unreasonable risk of injuries which may be caused by hazardous household products.”

The canvas of the Congressional mandate is huge. It empowers the Commission to investigate more than 200 kinds of products ranging from appliances to snowmobiles.

With such a bewildering array to probe, how does the Commission work?

First, it invites the public to speak up about product-related accidents. And the Commission staff does make on-the-spot investigations.

Most important, however, has been a series of good old-fashioned hearings. Four kinds of witnesses are invited to testify: victims of product-related accidents; experts in fields relating to the product; experts on state and local safety regulations; and industry representatives.

What have the hearings accomplished? In general, they've stirred up a healthy hubbub over the whole issue of product safety. And here are some specific gains: The Commission

- Succeeded in getting the Underwriters' Laboratories

to withhold the UL seal from the electric cord of an appliance unless the whole appliance is approved. Many consumers thought UL on the cord meant a blanket okay of the whole electrical system.

- Recommended legislation (signed into law by President Nixon on November 10, 1969) aimed to protect children from toys and other articles that have electrical, mechanical, and thermal hazards.

- Prompted action in the sporting-goods industry to develop a safer football helmet.

- Worked to persuade manufacturers to install the same safety latches on freezers as they now do on refrigerators—to prevent child entrapment—and proposed both a nationwide education program and an amendment to existing legislation to remedy the problem.

- Induced the American Gas Association to withdraw certification of floor furnaces, whose grates were found to be scorching thousands of persons a year.

- Prevailed on manufacturers and retail outlets to recall and modify, or drop entirely, various unsafe products such as motorcycle goggles (highly flammable), gas stoves, coffee dispensers, hair curlers, and—oddly enough—bathroom scales.

- Shocked the Federal Housing Authority, the National Association of Homebuilders, and many local and state bodies into requiring greater use of shatterproof glass in doors, adjacent glass panels, and shower enclosures after a particularly grisly hearing detailed numbers of deaths and mutilations from walking, running, and falling through glass.

Of course, the work of the Commission has not been without controversy—understandably. To cite the key words in the Act establishing the Commission, the consumer is to be protected from *unreasonable risk of injury*, and “unreasonable” is subject to many legitimate interpretations. Almost any piece of equipment can be used hazardously if only one tries hard enough. And many are intrinsically risky because of their very function: A saw is dangerous because it is designed to cut. No reasonable man, however, would seek to outlaw saws on that basis. Rather, manufacturers emphasize, users must learn to use tools safely. But any hazard that reasonably *can* be avoided, in the view of the Commission and of many consumer groups, *should* be avoided. To put it simply, if a man cut his throat while shaving with a straight razor, he has no grounds for complaint. But if he gets a shock from an electric shaver, the manufacturer has something to answer for.

Many industries have adopted safety codes, but the results have been variable. For example, the Chief of the Commission's Investigation Unit testified at a Portland, Ore., hearing in June 1969 that his investigators had checked 216 makes and models of power mowers and found that 55 of them did not meet voluntary safety standards. Yet all but 16 carried “safety seals” indicating compliance with the standards.

Most of the offending mowers were on sale in discount stores or other outlets specializing in cut-rate merchandise. Unfortunately, the Commission's research shows that the cheaper the product the greater the likelihood of hazard, even within a single manufacturer's line.

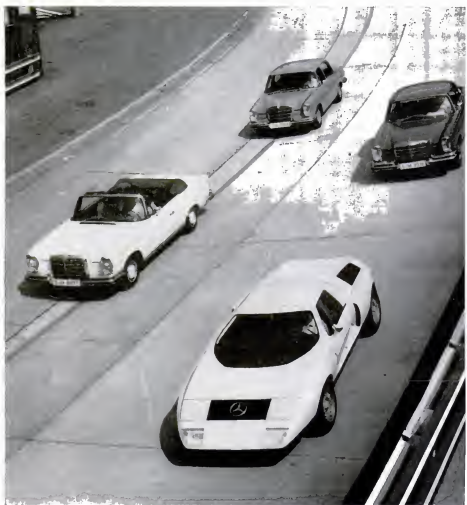
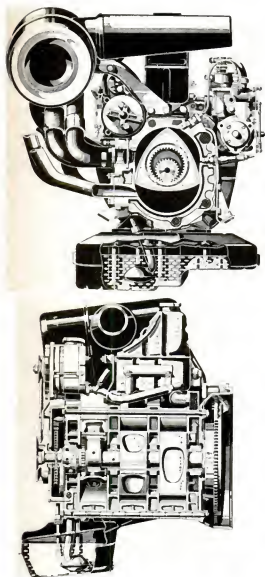
The most recent probe by the Commission highlights its philosophy on product safety.

Last fall, the Chairman of the Commission, Arnold B. Elkind, issued a statement on fire hazards in color TV sets. Using data from such sources as municipal fire departments, the National Fire Protection Association, and the International Association of Electrical Inspectors, the Commission estimated that between 5,000 and 10,000 fires a year originated in TV sets—mainly color TV sets.

Now, the Commission recognized that these figures are

[Continued on page 152]

Now the Wankel Is Ready



Mercedes-Benz C-111 engine (left) is the most advanced Wankel engine in existence, with three rotors, electronic fuel injection, and transistorized ignition. The factory insists it's strictly experimental at this stage, undergoing tests in various types of passenger cars, from the C-111 sports car (above) to the conventional sedans behind it. How long before Mercedes-Benz announces a regular production car with a Wankel engine? Our guess: within three years.

Are we dreaming, or is the rotating combustion engine ready to fulfill its promise?

By JAN P. NORBYE
PS Automotive Editor

When Popular Science first told you about the Wankel engine 10 years ago, we pointed out its great advantages over conventional piston engines, such as low weight for a given power output, small space requirement, almost vibrationless running, exceptional high-speed capacity, smoother torque delivery, and multi-fuel capability.

As its development progressed, we gave you stories that explained its problems: sealing and lubrication, chatter marks on the working surface, and relatively short life.

Now, with the intensive development work carried out by Mercedes-Benz in Germany and Toyo Kogyo in Japan, these problems are no longer serious. I told you last month about my experience of driving the C-111 (above); now I'll explain what's inside the engine. Also, there's the Mazda car, built by Toyo Kogyo. I'll get to that later.

First a reminder. If you've forgotten how the Wankel engine works, look it up in our April '66 issue, where we had a feature story on the Curtiss-Wright RC2-60 engine.

Now for this marvel that powers the Mercedes C-111. First, the output is 330 hp at 7,000 rpm for an engine weight of only 308 pounds! (A 335-hp Ford V-8 weighs 630 lbs.) Next, let's consider the things that used to be problems:

Chatter marks. Mercedes solved this one with a unique nickel-silicon coating on the aluminum working sur-

faces of the rotor housing, which gives a more compatible interface with the malleable cast-iron rotor.

Lubrication. That's such an important thing because the apex seals cannot do their work unless properly lubricated. The C-111 engine has a special drip-feed oil pump that meters minute quantities of oil to sleeves in the intake ports (see photo). The sleeves have a cavity that holds an oil film over a large sector. The incoming air carries part of the oil film in with it, but not in the middle of the airstream, where it would form part of the mixture and be wasted, but along the metal surface, where it is deposited on the apex seals.

Sealing. Proper apex seal lubrication assures both effective sealing and long seal life. The new simplified type of apex seal (see drawing above) allows both radial and diagonal movement to relieve seal stresses during pressure reversals and to prevent car-

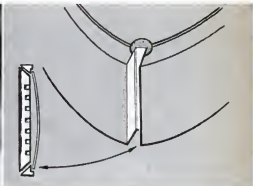
to Power the Car of Tomorrow



C-111 main shaft has three eccentrics spaced at 120 degrees carrying the rotors. Eccentrics are drilled for lightness.



Triangular cavity (nearest thumb) on intake port sleeve assures a constant oil film for seal lubrication.



Apex-seal spring loading works from the sides. Dents in back edge of seal allow gas passage during pressure reversals.

bon deposits on the working surface.

Some additional features:

- Electronic fuel injection (with Bosch equipment) assures accurate metering of the fuel to meet exact needs under all conditions.
- The fuel injectors are not fitted in the intake ports but in the front portion of the combustion chamber and aimed into the deepest and most turbulent part of the rotor cavity for optimum atomization of the fuel.
- Fuel delivery is completely cut out on the overrun, which prevents misfiring, reduces harmful exhaust emissions, and saves gas.
- The transistorized ignition system uses one surface-gap spark plug per chamber, which assures a strong spark at extremely high rpm, at very high operating temperatures, and even with deposits on the electrodes.

I mentioned exhaust emissions. That's still a weak point. I haven't called it a problem because it does not affect the successful running of the engine, but it's a question that must be solved before mass production can be contemplated. Actually, it's mostly a matter of cost. A conventional air-injection reactor pump can be bolted on, and will bring the engine within present U.S. limits. But not future limits. The afterburner probably will, but the afterburner is effective only at very high temperature.

There will be unacceptably high emissions on cold starts, and there's the additional problem of finding materials capable of withstanding continuous running under load. Mercedes-Benz has an entire laboratory with at least 30 differently equipped Wankel engines doing nothing but emission research. The lab has a liberal budget, for the company is not only determined to reach a solution, but to reach an adequate long-term solution, and to reach it quickly.

In Japan, Toyo Kogyo is just as determined, but seeks solutions by other methods. The Mazda R-100 and R-130 have twin-rotor engines and share the principal design features. Mazda uses carburetors only, but has adopted twin intake ports per chamber, which raises gas velocity and improves atomization of the charge. Each chamber has one side, and one peripheral, intake port for the best combination of high rpm and low-range torque. Both engines have dual ignition, too. Each chamber has two plugs, firing five deg. apart, with two coils and two distributors to maintain spark intensity at high rpm.

Mazda mixes oil from a separate metering pump into the intake charge for apex-seal lubrication. The interfaces of a hard-chrome wall and a high-carbon-content iron seal have excellent compatibility. The oil needed

for lubrication is negligible, since carbon has self-lubricating qualities.

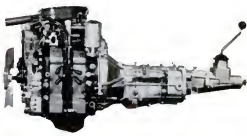
For reduced exhaust emissions, Mazda has developed a preheating system, which circulates hot exhaust gases not only in separate channels of the intake manifold but also through channels in the casing. This warms up the incoming charge during the entire intake phase and part of the compression phase. The engine also has an air-injection reactor with its nozzle at the lip of the exhaust port. The dual-cell recirculation-type reactor, in combination with the spark retard made possible by dual ignition and the preheating of the intake mixture, has resulted in the Mazda R-100 passing the U.S. Federal Exhaust Emission Control Standards.

Speaking in terms of production, Toyo Kogyo has taken the lead from NSU, which was first with a Wankel-powered production car. Every month, 1,000 Mazda R-100s roll off the lines. In such small numbers, the Wankel engine is still more expensive than equivalent piston engines, but Toyo Kogyo feels that the Wankel will be cheaper when they are making 25,000 a month. That's logical, for the Wankel has half the number of parts. But how soon will that be? Toyo Kogyo aims to equip all its passenger cars with Wankel engines within a year or two.



Mazda R-130 is powered by a 126-hp twin-rotor Wankel engine driving the front

wheels. Top speed approaches 120 mph. R-130 is now in regular production.



Mazda R-100 engine is coupled to rear-drive transmission, delivers 110 hp.

Revolutionary New Mixer Has No



How Static Mixer mixes without moving parts is shown above. Toothpaste (left) has red stripes through white paste when it leaves container. But when it is squeezed through the mixing tube (center), paste is blended as it is repeatedly divided by bow-tie-shaped elements (right). By the time paste gets to the end of tube, it is pink all through.

Motionless, it blends liquids, gases, solids by a process of "long division"

The science of mixing has been given a new twist—a series of bow-tie-shaped elements that make beating, shaking, or whipping just plain old-fashioned.

The elements are the heart of the tube-shaped Static Mixer, made by the Kenics Corp., Cambridge, Mass. It mixes free-flowing solids, viscous liquids, slurries, pastes, even gases—with nary a moving part. The device was developed jointly by Kenics and the Arthur D. Little Corp., which holds the patent for the mixer.

The motto of the Static Mixer could well be: "Divide and conquer." The little metallic bow ties are arranged in a tube so that left-twist and right-twist pieces alternate down its entire length. Then whatever material—or combination of materials—you want to mix is poured into the tube. As it flows over the first bow-tie element, the material is split twice. Then each of the halves is split again by the next element. Each element doubles the number of parts into which the material has previously been split. Thus,

Now, transparencies to enlargements..

New photo system lets you enlarge B&W film or color slides without a negative

A unique electrostatic photo-printing system *really does* accentuate the positive, eliminate the negative.

It's the O/G Chroma system. It makes enlargements and contact prints directly from positive black and white or color transparencies without

an intermediate negative. And it does this in a nonchemical process with unsilvered paper. The entire process takes less than two minutes.

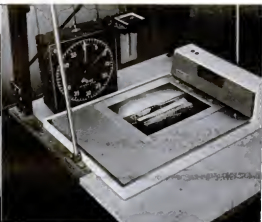
The print paper is electrostatically charged on the enlarger easel, and then selectively discharged according



You use your own enlarger with the 10/G Chroma electrostatic printing system (above). Opto Graphics kit costs \$385.



How O/G system works: After focusing image on paper, you sensitize print by moving charging device across easel.



You expose the transparency in your enlarger in the usual manner (total darkness is not a requirement for this process). Then:

Moving Parts

a material that flows through 21 elements is minced more than two million times. One, flowing through 31 elements, is divided more than two billion times. Want a finer mix than that? Just add more elements.

There is no practical limit to the size of the mixer or the viscosity of the material that can flow through it. Kenics has already made mixers up to eight inches in diameter.

Only the material moves. When the material enters the tube, the outside of the fluid stream travels farther than the inside because of the helical shape of the elements. Split layers are thus constantly moved back and forth. This churning action further improves the mixing process. Yet inside the mixer nothing moves except the material.

The amount of material, the time it takes to flow through the tube, and the speed of its flow are all immaterial to the resulting mix. Only the number of elements determines how many times the mixture is split, and therefore, the degree of blend. Mixing is complete after one passage through the element-fitted tube.

So far, the Static Mixer has been used exclusively by industry to mix powders, including explosives; extrude synthetic fibers; manufacture emulsions; and produce marbled floor tiles. But it may soon turn up in your neighborhood paint store to mix paint color to your order. It would be neater than the mixers now used for this purpose, and could produce a superior blend.

Electrostatically

to the pattern of enlarger light: Dark areas retain their full charge; gray areas, a partial charge; white areas, no charge.

The paper is "developed" in a toner suspension containing oppositely charged pigment particles. These, attracted to the paper's charged areas, form the images.



You "develop" the exposed paper in toner for 30-45 seconds. Then it's rinsed with water and dried. Finished print that is produced is permanent.



IMPULSE SHOWER Has a Built-In Swedish Massage

Push a button and this spine-tingling shower replies by spewing alternating jets of hot and cold water that pelt your skin from all sides.

Made in Sweden by Dometic, it has no faucets.

Electronic controls regulate the water flow into a series of short pulses. The hot-water pulses last two seconds, whereas the cold-water pulses can be adjusted to last from one-fifth of a second to 10 seconds. You can also shut off the cold water completely if you wish. There's a one-second pause between the pulses.

The pulsing jets of water seem to massage your skin. In addition, the hot pulses open the pores and the cold pulses close them. This makes the skin work constantly and steps up circulation to provide that invigorating, Swedish-massage effect.



Dometic shower looks like ordinary stall type, but has no faucets. Push-button controls start water pulsing from every corner.

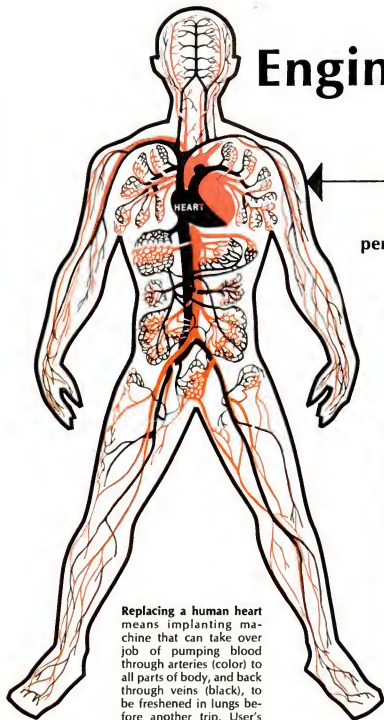


Overhead spray and hand-held spray also emit pulses of water. Thermostat guarantees water never hotter than 113 degrees. Cold water can be shut off completely.



Engineering the New MECHANICAL

An army of engineers and doctors is close to perfecting an amazing device that could save your life by beating 42 million times a year



Replacing a human heart means implanting machine that can take over job of pumping blood through arteries (color) to all parts of body, and back through veins (black), to be freshened in lungs before another trip. User's life hangs on unflinching 42 million beats a year.



Artificial heart of Kolff design now combines two pumps in one unit. Housing of Silastic-impregnated Dacron mesh contains collapsible sacs that pump blood. Wires are to monitor pump action.

By CURTIS MITCHELL

A telephone rings in the hospital's stockroom. The clerk picks up the receiver. A surgeon's voice is urgent: "I need a cardiac PD fast. Series M-40. Got it?"

The clerk scans his shelf. "PD" for prosthetic device—an artificial spare part for a human being, specified by "cardiac" as a heart. "M" for male. Forty for age 40 to 50. He takes down a sealed carton, half the size of a shoebox, containing an already inspected and sterilized mechanical heart. "It's on the way," he says, marking an operating-room number on the box.

That exchange will really take place some day. And the patient who needs the heart could be you.

Heart disease, America's Number One killer, now causes three deaths out of eight. Thousands of those lives will be saved when a patient's heart, too far gone to keep him alive, can be removed and replaced by a mechanical substitute.

Despite the new medical marvel of transplanting human hearts, there will probably never be enough donors to meet the surging demand. And the suspense of a patient in desperate need of a new heart—which he can obtain only when death comes to a prospective donor—is agonizing. Small wonder, then, that surgeons dream of an artificial heart. Today, a small army of engineers, mechanics, tinkers, physiologists, and doctors is working to make that dream come true.

Government leads quest. Headquarters of U.S. efforts to perfect a mechanical heart is the National Heart Institute, which has spent more than five years and upward of \$90 million on its Artificial Heart Program. Currently, this government agency is underwriting the endeavors of more than 100 research teams in scores of leading medical centers and industrial laboratories.

More than 30 different heart pumps have been created by the government's contractors. Most of them have been tested in mock-ups of the human circulatory system. Extensive testing in animals is the next step. And finally, use in human patients.

What NHI seeks is a device far more advanced than the one and only

Mechanical heart, like human one, has twin pumps with functions noted. Pictured Koff-type pumps are powered by pulses of air; asterisk marks one air-inlet tube. Complete implanted package would also provide driving "engine" and energy source.

HEART

"total" artificial heart implanted in a patient (up to this writing).

In that dramatic and controversial episode last April, a prototype mechanical heart designed by Dr. Domingo Liotta replaced the natural one of a 47-year-old man in a Houston hospital. It served him for three days, until a donor could be found for a human-heart transplant; following this second operation, the patient died. Dr. Denton A. Cooley, the heart-transplanting record holder who headed the surgical team, maintained that the Liotta heart had successfully fulfilled its stopgap purpose of keeping the man alive during the hunt for a human donor.

Critics at Baylor University Medical College, where the Liotta heart had been under development, held it insufficiently proven for human application and called Dr. Cooley's use of it "unauthorized."

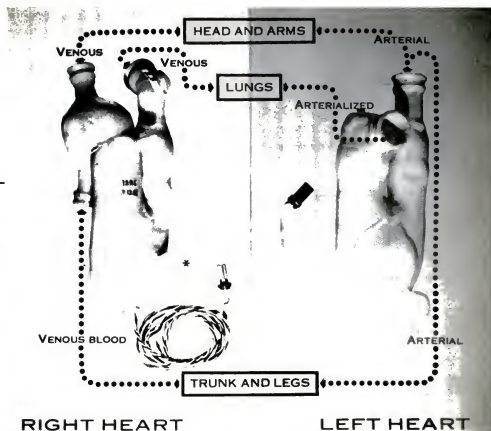
Regardless of the dispute clouding this medical "first," it is clear that this prototype was far from the self-contained artificial heart being sought. The heart-like half-pound pump of plastic and Dacron implanted in the patient had to be operated by gas pressure through tubes from a bedside power console as big as a refrigerator. Forward-looking planners envision, instead, a mechanical heart so compact and portable that its owner can move about freely and live a normal life.

Two kinds of artificial hearts. A "total" mechanical heart, which completely and irrevocably replaces a man's natural one, is one principal goal of NHI's Artificial Heart Program. But it is not the only one.

Another objective is a "booster" heart—an auxiliary pump that would not replace your own heart, but would be implanted to assist it, temporarily or permanently. By easing the burden on an ailing heart, a booster would give the body a better chance to make repairs—and avert further damage.

Such a device could save your life. And its timely help in repairing your own heart could spare you from spending the rest of your days confined to a bed or a wheelchair.

For every patient who needs a "to-



RIGHT HEART

LEFT HEART

tal" heart, NHI estimates, there are 10 who would benefit from a heart-assisting booster. Current research can advance work on both kinds of artificial hearts at once, because so many problems are common to each—suitable blood pumps, engines to drive them, and sources of energy for the engines.

A booster heart was first implanted in a human patient as far back as 1963, by Dr. Michael DeBakey, at Baylor University Medical College in Houston. His booster, like the Liotta total heart, had to be attached by tubing to an outside source of power.

Progress since then was exhibited by NHI last November, when it displayed four kinds of completely im-

plantable booster hearts—and two live examples of the 200-pound calves in which all four hearts had been experimentally implanted. It was the first time, NHI said, that the hearts' electric, hydraulic, and thermal components had been brought together as "complete functioning systems."

All four boosters have a hydraulically actuated blood pump. The double-valved device connects the bottom end of the heart's left ventricle to the descending portion of the body's main artery, the aorta. Alternate entry and withdrawal of water, between the pump's rigid housing and its flexible blood chamber, pumps blood forward—relieving the natural heart of most of its effort to supply



Calf with implanted "booster" heart gets the batteries recharged by a coil held over skin. The visible air tube inflates cuff that blocks coronary artery to simulate a heart attack; then, "booster" effects recovery. Exterior wires monitor the calf's heart and the booster.

life-giving blood to the human body.

Where these boosters differ radically is in the source of power for the water-cycling hydraulic unit:

Implantable "power packages." Two of the boosters use tiny electric motors, implanted together with their rechargeable nickel-cadmium batteries. By induction, electric energy can be transmitted right through the intact skin to recharge the batteries. In one system, a surgically formed tube of skin encases a doughnut-shaped secondary coil, and an external primary coil is inserted in this tunnel. In another system, both coils are pancake-shaped, and one is placed on top of the other, with skin between.

Heat engines drive the other two boosters. Electricity, supplied from outside by induction, melts a lithium-salt mixture in an implanted stainless-steel container insulated with 80 layers of titanium foil spaced with zirconium powder. Liquefying at 930 degrees F, the molten salt forms a reservoir of heat energy.

In one booster, this heat turns water to steam and drives a midget implanted steam engine. (Exhaust steam is condensed, and the water used over again.) In another booster, the heat pressurizes helium gas to drive a miniature engine of the Stirling "hot-air" type. The mechanical energy of each heat engine pumps water into a high-pressure reservoir, and its hydraulic pressure drives the hydraulic blood pump.

For the benefit of future heart patients, the calves testing these devices are given simulated heart attacks. Implanted at the same time as the booster package is an inflatable rubber cuff around the animal's left main coronary artery. The blocking of this vessel by fatty deposits or blood clots accounts for most human heart attacks. Inflating the cuff, via an outside tube, clamps the artery shut—and the stricken animal loses conscious-

ness. Then the booster package is set in action.

Results of these trials are called "beautiful" by Dr. Frank W. Hastings, chief of NHT's Artificial Heart Program. Within 15 to 20 minutes, the calves have regained consciousness as the booster takes over the job of pumping blood. The implants have functioned effectively up to six weeks.

Next—the "total" heart. A "total" mechanical heart will be a more formidable project in many ways. Above all, it must be of fantastic reliability for a man to give up his own heart and trust his life to it. Its designers face specifications as demanding as these:

- It will be expected to pump continuously for 10 to 50 years without a breakdown.

- It must be strong enough to circulate the body's five to six quarts of blood through 60,000 miles of arteries and veins . . . and, in a lifetime, move a total of 65,000,000 gallons of liquid, enough to fill the Rose Bowl stadium to the brim.

- It must automatically adjust to the body's need, with pumping speed suitable for snoozing or for sexual intercourse.

- It should be no larger than a pear, and weigh about the same.

- Its power supply should be self-contained and self-charging.

- It must cost, installed, no more than a medium-sized car.

The ideal model probably would be a plastic or metal duplicate of the human heart, whose two side-by-side chambers beat as one. Receiving blood from the veins, the right-hand pump pushes it through both lungs to be cleaned and oxygenated, and thence back to the left-hand pump. In two-ounce spurts, this chamber pumps it out into the main blood line—the aorta—that feeds the body.

Each succeeding beat forces the blood further along the arterial tree—

arteries, arterioles, capillaries—until its corpuscles reach all the body's 300 trillion cells. Then, delivering its oxygen and picking up waste, it begins the return journey through the veins.

Sturdy bands of muscle, encircling the pumping chambers, are the human heart's "engines." The muscles contract, squeezing the blood through one-way valves into feeder lines, in response to a tiny electric shock. Its seat is called a pacemaker—a knot of very special nerve fibers in the top of the heart. When chemical reactions build up an electric potential to a certain level here, the pacemaker "fires" and the heart muscles are triggered. At rest, this happens about 70-80 times a minute.

Over a year, the faithful "lub-dub" of your heartbeat is repeated some 42 million times. A fraction of a second between beats suffices for your heart muscles to rest.

Here is a look at the components taking shape to duplicate this natural wonder mechanically, and at the problems to be surmounted:

The pump. Moving blood through any man-made system is hazardous. When corpuscles and platelets in blood become fragmented, blood may clot, or fail to pick up fresh oxygen. In some early pumps, corpuscles seemed to be ground to bits in passing through plastic valves, tubes, and chambers. Piston-and-cylinder pumps were especially troublesome.

Materials, too, are a problem. They must have incredible smoothness—and enough strength to withstand flexing hundreds of millions of times.

A prototype that may point the way to success is the Kolff pump, developed at the Cleveland Clinic by Dr. Willem J. Kolff. In its present form, it closely resembles the human heart. Its semirigid housing is of molded Dacron mesh impregnated with Silastic. An inner collapsible sac, one for each ventricle, receives and discharges the blood. Both chambers fill and empty in response to the pulsing of a gas or liquid, forced between the sac and its shell. Animal tests must eventually prove or disprove that this heart will do its job in humans.

There are many other designs. One pump has waving metal petals that press gently, one after another, against rubber fingers full of blood.

The "engine." Ideally, the motive power of an artificial heart should be implanted in a closed chest. Wires and tubes penetrating the chest wall would limit mobility, and present a hazard of possible infection. NHT's booster experiments with calves illustrate some possible choices of an implantable power source for a total heart: electric motors with recharge-

[Continued on page 142]



Artificial heart replaces human one in first-ever operation by Drs. Denton A. Cooley (right) and Domingo Liotta to keep alive patient awaiting human-heart donor. They implanted Liotta-designed plastic heart, above, connected to bedside power source.

New Four-Eyed TV Lets You See What You're Missing

With this new German TV you could monitor three black-and-white channels while watching a fourth in full color

By DAVID SCOTT

If a Britisher has 850 pounds (about \$2,000) to spend on a telly (TV to you), this four-eyed monster from West Germany is without doubt the biggest, most complicated, most versatile set for him. It has four picture tubes: a man-size 25-inch for color, and three 5½-inch black-and-white monitors.

The giant set isn't presently being made to receive American TV signals, but here's what it will let you do if and when available here: You could watch one program on the big screen while keeping an eye on what's doing on three other channels. When the game at Yankee Stadium flags and the movie looks good, just push a button to swap the pictures. Comes excitement at the ball park, you know it, and can switch it back to the large screen. Or you can skip commercials, yet not miss a moment of the action when they're finished.

This giant machine weighs 215 pounds, and has 25 tubes and 96 transistors and diodes. It's actually *four* TV receivers in one cabinet. The color set is pretuned to any four channels, with an electric solenoid-operated turret allowing pushbutton switching, either on the front panel or from a remote-control box. The three monochrome circuits, on a separate chassis, pull out like a drawer for servicing. Each can be tuned to two channels.

When you select a program from one of the monitor screens, the picture transfers instantly to the color tube, and the new channel number is displayed on an electronic digital indicator alongside the tube. The rejected program jumps to the vacated monitor tube.

Sound is also transferred, of course. But you can get simultaneous earphone reception of any of the monitored channels. The phones plug into the front panel, and you can switch to any program for private listening. Thus Mom can take in *Lucy* with the headset while the rest of the family chuckles at *Laugh In*.

Controls are simple. For the color tube, there are the usual brightness and contrast, and a hue selector that slightly emphasizes red or blue, or automatically locks onto the correct color balance. In addition to a volume control, there's a lockable on/off switch to personalize the box for the family key-holder. The three monitors have only brightness knobs and individual on/off switches. Sound is fixed.

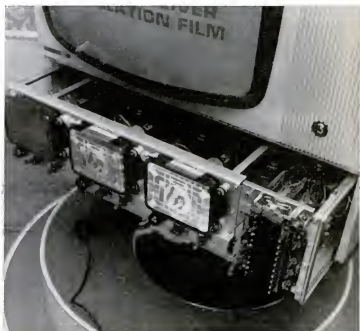
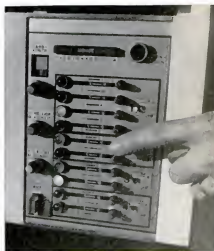
The set, made by Norddeutsche Rundfunk and shown by British Relay, Ltd., of London, is primarily intended for TV critics, journalists, actors, and other professionals. But with a little patience and a lot of money, you, too, may own one someday.



A big machine by any standard is a Norddeutsche Spectra Color Studio. You can select programs at front of set or by remote controls.

Control panel has push-button channel selectors for each of the four screens. Channel-tuning knobs are sleeves fitted on pushbuttons.

Monitor chassis pulls out like a drawer for servicing when the front panel is removed. Chassis is made up of three television receivers.





She's a lively performer, even with the smallest engine option—a 120-hp OMC

stern drive. With six aboard, she climbed onto a plane in four seconds. Hull is of

cathedral design with molded-in strakes and deep tunnels at the sides for added stability.

PS Tests the SEACAMPER... New Breed

Launch this slick family camper and you're afloat in a houseboat—a combination sure to click in the 70s

By JIM ROE / PS Boating Editor

If you're a boating enthusiast, you'll call it a small but sturdy houseboat. If camping is your bag, you'll call it a completely equipped trailer home. And in either case you'll be accurately describing the SeaCamper.

This 24-foot family-size toy is one of the bright lights in a new breed of boat that I predict will become one of the great success stories of the Seventies. These new craft provide live-aboard capability for a whole family, not only afloat, but enroute to the

water, and in any campground or parking lot. All this in a good-looking package, too; and at a price that—while healthy—can be managed and justified by many families when they reckon the years of vacations and weekends that become possible without the attendant high cost of hotel rooms and restaurant meals.

Best of all is the absolute freedom these plucky little boats give you. Other examples of this new breed include the Amphicraft, made by Master Plastics, and the Golden Viking by Canadian Leisure Industries.

The SeaCamper is a brand-new boat. In fact, at the time of our PS test, the company itself (SeaCamper Industries of Jacksonville, Fla.) was still nearly four months short of its first birthday.

The SeaCamper hull. For the 24-foot craft, with its eight-foot beam, designer Otis Borum created a cathedral

hull with variations. One variation is a set of longitudinal strakes molded into the fiberglass hull on each side of the center keel. Another is a pair of deep molded-in tunnels between the center and outer keels. These not only add stability to the hull on the water, but are the key to improved stability for trailering; the longitudinal trailer supports sit neatly in the deep tunnels. The hull flows back to a modified-deep-V configuration at the transom.

The deckhouse. When I stepped aboard the SeaCamper, I was first impressed by its clean design. The deckhouse is admittedly large for a 24-foot boat. But it is well-scaled and not unpleasant to the eye. Inside the deckhouse, I admired the SeaCamper's thoughtful accommodations.

The driver's station is well forward and to starboard. I found it most adequate for approaching docks, and certainly ideally placed for a good view forward and to starboard—a pilot's danger zone. A well-placed door to the deckhouse gives a good view of oncoming traffic.

Running the length of the forward port section of the deckhouse is a full-length divan. With little effort, this provides good sleeping space for one. The back of the solid-fiberglass driver's seat also folds down, forming another single berth in the forward section of the pilot house.

Amidships and to starboard, the



Golden Viking (Canadian Leisure Ind.) won first 100-mile houseboat sea race.



Amphicraft—camper, houseboat, and floating patio—is made by Master Plastics.



120-hp stern drive pleased Roe. At right is Herb Piker, SeaCamper firm's president.



Control station and professional instrumentation of the SeaCamper are impressive.

She's a camper on land as well as on water. On the specially designed trailer the Sea-

Camper tows easily, giving you living accommodations including toilet, shower.

of Trailer/Houseboat

SeaCamper boasts a three-burner range and oven as standard equipment. Amidships to port is a fully enclosed stand-up head equipped with a toilet (holding-tank type) and a for-real shower. There is even a fold-up shutter to cover the porthole in the head, making it unnecessary to share one's ablutions with the dockside crowd.

At the stern end of the deckhouse, on the port side, is a full-size dinette. This, of course, becomes a comfortable double berth. A combination 12- or 115-volt refrigerator is under the forward dinette seat.

The afterdeck. Now, let's step out the aft doorway. Here one finds an engine-hatch cover similar to that on a full-size houseboat. The SeaCamper comes with options of 120-hp to 160-hp OMC or MerCruiser stern-drive units. It is also completely equipped with bilge blower, bilge pump, and all other necessary safety features and deck hardware.

There is one more pleasant surprise on the afterdeck. On the port side, at the stern, is a recessed fold-up stairway. Simply pull on the lanyard and it hinges down into the water. This becomes a handy boarding ladder when you're afloat. Just as important, it makes the SeaCamper into a truly accessible camping trailer when you bring it ashore.

Foam flotation isn't limited to the lower portion of the hull; it is also in

the side and roof sections of the deckhouse. This provides positive flotation to help keep the SeaCamper upright if flooded, and also provides insulation against both heat and cold.

Test run. I took the SeaCamper out on a sunny day in calm waters. There was a moderate wind, which only served to convince me that Otis Borum had done his hull designing well. The craft tracked straight and true across wind even at moderately slow speeds.

We had to make our own rough water, by zigging, zagging, and circling. Traveling through our own wake and chop, it was evident that this hull has all the stability of cathedral design and some of the chop-smoothing tendencies of the deep V. This boat will take your family out and bring it back in safety.

At the time of the PS test, the SeaCamper was offered only as a stern-drive model. But as you read this, it may be appearing in two other forms. One: an outboard version, allowing you to adapt your horsepower from a very low range to a high range, depending upon the waters you intend to cruise and the use you intend to make of the boat. The second version: a deluxe SeaCamper, complete with air conditioning and other niceties.

With the refinements aboard, you may find the SeaCamper as comfortable as your home. You might even decide to park it in your driveway and camp there all summer.



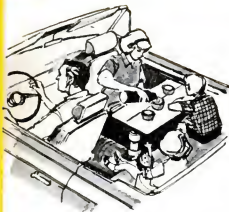
Full-size dinette (top) converts to double berth shown below it. SeaCamper provides stove, refrigerator, stainless-steel sink, even the curtains as standard items.

SEA CAMPER SPECS

Length at centerline	24' 1½"
Beam amidships	8'
Beam at transom	8'
Cabin dimensions	17' by 17'
Head room	6' 6" max.
Height from waterline	7' 4"
Height overall on trailer	9' 11"
Freeboard forward	29"
Freeboard aft	27"
Boat weight	4,410 lbs.
Trailer weight	1,180 lbs.
Price (as tested)	\$10,795

NEW IDEAS FROM THE INVENTORS

ILLUSTRATIONS BY DANA RASMUSSEN



Swivel seat faces table. A floor-mounted table, according to this recent Chrysler patent, could serve as a work or dining surface for a car's rear-seat passengers and the occupant of the swing-around front right seat. Folded and turned, the table would form an armrest between front bucket seats.



Finger knife peels fruit. This curved, finger-fitting knife might make it easier to peel an orange or other citrus fruit without squirting juice. The depth-limited blade would score the orange's skin; you'd then insert the tapered tip of the peeler to pry up and separate the loosened skin sections of the orange.



Plastic cap protects plants. Supported by a hollow post, this perforated plastic bag would admit both air and sunlight to a seedling or young plant while protecting it from wind and chills. Arms on the stake would shape and hold the cover; below-ground openings would channel water to the roots.

Wiper drains roller. You could clean a paint roller faster after use with this combination. Can-top support and a shaped, hinged scraper would let you apply pressure you needed as you worked excess paint back into the can. In addition to saving paint and solvent, the scraper would simplify clean-up and preserve roller covers for re-use in the same or another color.



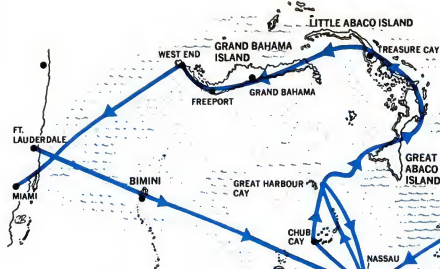
Rake blades scrapes snow. Slipped over the tines of a garden rake, this sharp-edged scraper blade would let you use both the strength and shape of the rake to clear snow off sidewalks and driveways or scrape up stones and other loose matter. The metal—or metal-edged—blade would extend below and beyond the tines. In gardening season it would simply slip off.



Tilt crane loads trailer. A boom on the tail ramp of this multi-use trailer would let you winch heavy or awkward cargo up onto the steel-plate bed. You could unload either by winch or by tilting the bed and ramp on the centered axle. A multi-position hitch would allow for towing and tilting. Raised girder sides would provide drive-on towage for a vehicle as well as a cargo pit. Also, the two-level bed could easily be adapted for carrying a modest-size boat.

The following patents have been issued on these inventions: Swivel seat—No. 3,391,960 to R. Megargle, Grosse Pointe Park; D. Long, Birmingham; and W. Bachmann, St. Clair Shores, Mich.; Plant cap—No. 3,373,525 to D. Canisio, New Berlin, Wis.; Peeler—No. 3,397,456 to W. Exer, Heron Lake, Minn.; Paint scraper—No. 3,373,456 to G. Dalton, Kayesville, Utah;

Rake edge—No. 3,397,469 to E. Browning, Riverdale, Md.; Winch trailer—No. 3,460,696 to C. Owen, Jr., White Plains, N. Y.
Copies of patents may be ordered, by number, from Patent Office, Washington, D. C. 20231, at 50 cents each. To write to an inventor, address him by name and patent number in care of the Commissioner of Patents.



Piper Comanche winged four of us over 1,500 miles of open ocean without missing a beat. A great flying citizen, the 260-hp plane has a 185-mph cruising speed and a 1,300-mile range.

The Crazy, Tricky, Wonderful Sport of

ISLAND HOPPING

For fun and adventure, try exploring the Caribbean in your own airplane

Wow! That's my one-word report on a 1,500-mile open-ocean flight we've just made over the Bahamas Islands. It's a pilot's paradise of incredible beauty—sand-fringed greenery set in a coral-shadowed ocean.

This flight is not for the brand-new, wet-eared private pilot. Even in a muscular, dependable Lycoming-engined Piper Comanche 260C, you're constantly on the edge of your seat while flirting with the big briny.

But you don't need the 5,000 hours of flying time my copilot Tom Hul-

By NORBERT AUBUCHON

PHOTOS BY JOHN BAZZANO

ings and I brought to the cockpit, either. In fact, you don't even need to take a Comanche, with its 185-mph fast cruise and 150-mph slow cruise—the speed we used. A smaller, slower plane like the Cherokee 140 would do handily, depending on the total weight you haul. Cruising range isn't critical, because fuel is well deployed around the islands.

With 50 to 100 hours of cross-

country experience, plus sense enough to preplan (with particular attention to boning up on the tricks of open-water flying), you can open up an exciting new world. If you're still apprehensive, pick up a copilot.

You're not a pilot? Don't hang up. Just get to Miami, Fort Lauderdale, or Palm Beach and put together your own tour on any of several little airlines that spider-web the 700 islands. Or charter a piloted plane at Nassau. With five friends you can spend a wonderful day with 600 miles of is-

Continued

Cumulus clouds build up below as we watch through windshield. A daily occurrence in the Bahamas, it results in occasional showers.



Dual-control Comanche had complete instrument panel—all usual instruments, plus automatic direction-finding radio and omni-





Island hopping is tricky—cloud shadows look like islands, some landing fields have constant crosswinds, many islands are uninhabited. We were prepared to ditch: Bend over until plane stops, scramble out, inflate life vests and raft, activate emergency radio beacon.

land-hopping in a twin-engine plane for \$40 to \$50 each.

Getting ready. I picked up the Comanche at Piper's plant in Lock Haven, Pa., where I had a welcome checkout by instructor John Schuster. Then on to home base—New Garden Flying Field, near Kennett Square, Pa.—to prepare for the trip. But let's get to Florida, the usual departure place for the Bahamas.

Part of our homework was done the evening before jumping off from Fort Lauderdale. Tom and I described forced-landing procedures to our passengers. My wife, Pat, and our photographer, John Bazzano, sat around the dinner table wide-eyed and bilious as they learned about the difficulties of ditching a land plane in the ocean.

Finally, we all decided to think positively, and with that, "serenity" returned. After all, some 25,000 trips are made annually by private plane. Only about a dozen craft are lost, according to the U.S. Coast Guard, which covers the Bahamas with rescue craft from Miami and Puerto Rico.

The takeoff. Next morning at Red Aircraft, Fort Lauderdale International Airport, we had our plane inspected just to be sure. While the mechanics poked around, we checked out our rescue gear on rental from Red Aircraft. These people also prepared our customs/immigration papers and fueled the plane. They also helped us file the special flight plan necessary to penetrate the ADIZ (Air Defense Identification Zone), a 25-mile-wide chunk of air off our shores that is under constant scrutiny.

We used most of their services, but didn't need charts. I had collected aeronautical and nautical charts plus the extremely helpful Jeppesen data published by Jeppesen Times Mirror of Denver. Just tell these folks where you want to go. They'll put together the best set of radio navigation aids with detailed airport information, all at reasonable cost.

"Cleared for takeoff," rasped the Fort Lauderdale tower. With throttle eased full open, we rolled. A glance at the gauges said A-okay. The 260-hp

Flying over the Bahamas is



Copilot Tom Hulings stows gear; removing fifth and sixth seats enlarged cargo space. Tom secured everything to prevent shifting.



New tourist attractions are visible on many Bahamas islands like this one. They include resorts, sport facilities, vacation homes.

engine pulled the Comanche, the four of us, 250 pounds of luggage, and four hours' worth of fuel. The tiger-shark nose lifted. Gear up! At 112 mph, we spilled the flaps. Our airspeed climbed, streaking us and our 3,200-pound gross neatly over the beach.

With Fort Lauderdale still in sight, we turned to Miami radio, activated our flight plan to Nassau, and took a direct course for our first check point—Bimini. We were flying an outbound radial from the Fort Lauderdale omni (omni-directional radio range) and an inbound radial on the Bimini omni at an assigned altitude of 4,500 feet. I would have preferred a higher level but didn't argue. Bimini is only 53 miles away, so in 18 minutes we'd be there and gone, headed over the longer leg of 106 miles to Nassau. I glanced back at Pat and Johnny. They seemed relaxed and comfortable. The Comanche's ventilation system, incidentally, is great.

Jenny, a tropical low that never quite became a hurricane, influenced our entire trip. She sat fuming for

orth the extra precautions; you won't find more colorful, primitive sights anywhere



Talking over Piper's radio, author Aubuchon asks a passing airliner about the weather aloft. Such chats are routine in the Bahamas.



Ditching gear included inflatable vests as worn by Mrs. Aubuchon, hand-held radio beacon, and four-man inflatable raft (left).



Great Abaco Island juts out into the ocean below us. Abaco has its own water supply; many islands catch and store rain water.



Its gear down, our Comanche comes in for a landing at the posh Great Harbor Club. The club is aiming for the jet-set trade.



Chain of Exuma islands, many completely untouched, stretches to the horizon. It's one of the most beautiful areas on earth.

days some 200 miles northeast of the Bahamas. We were now taking her as a substantial headwind. (Later in the trip she gave us crosswind landing fits.) The cloud base was at 5,000 feet with tops at 6,500.

Until our eyes adapted, cloud shadows looked like islands, but Bimini demonstrated the difference between real and phony landfalls and introduced us to Bahamian waters: a blue-green-yellow kaleidoscope. Hues ranged, with water depth, from deep purple to midnight blue, then on to turquoise and aqua, finally ending in yellow and eggshell beaches.

Now we could really understand how pilots can navigate by water color. If lost without a compass, one experienced guy says to fly in wide circles. Steer for light-colored water, and then track it to a land mass.

With Bimini behind, we switched confidently to the Nassau omni. Its signal was loud and clear. We adjusted course slightly and relaxed, calmed by the assuring sound of the Lycoming and its efficient gauges.

Pat and Johnny, having seen Bimini, appeared enchanted.

Bad news. Suddenly the Nassau omni went out. I tensed. Bad news in an airplane often comes in little pieces. First one small thing and then another until they combine into something important. While making a quick calculation from our logged notes of the distance back to Bimini, I pointed at the omni receiver.

"What the hell," Tom growled. He twisted the on/off switch and changed the frequency to Bimini. Its signal

came in clearly; the radio was okay. Another glance at the charts showed that we couldn't miss a landfall, even with a gross deviation from course of 45 degrees.

As an anticlimax, the omni popped on again. Later an airline pilot confided that a new omni is sorely needed. Breakdowns occur daily. But there are low-frequency radios throughout the islands—handy if you have a direction-finding radio. Even if you don't, you can almost always

[Continued on page 118]

Water's edge on Treasure Cay, Great Abaco, typifies the unblemished Bahama islands.





An aerial tram will carry travelers between Seward's Success and Anchorage. Travel within the glass-enclosed city will be on moving sidewalks, a rail system beneath city's spine, or bicycle paths. No cars will be permitted, so there will be no exhaust to pollute air.

An Entire City Under Glass

An Alaskan metropolis will begin to take shape this summer to provide offices and homes for 40,000 live-ins who will enjoy a year-round ideal climate

By JIM DAVIS

The world's first completely enclosed city will start to rise in a few months, and eventually will house 40,000 people in a climate-controlled environment.

The city is being built two miles northwest of Anchorage, Alaska, and is named—with a respectful bow to a damaged reputation—Seward's Success. It was designed by Adrian Wilson Associates, of Los Angeles, to accommodate the enormous boom that Anchorage is expected to enjoy because of Alaska's oil bonanza.

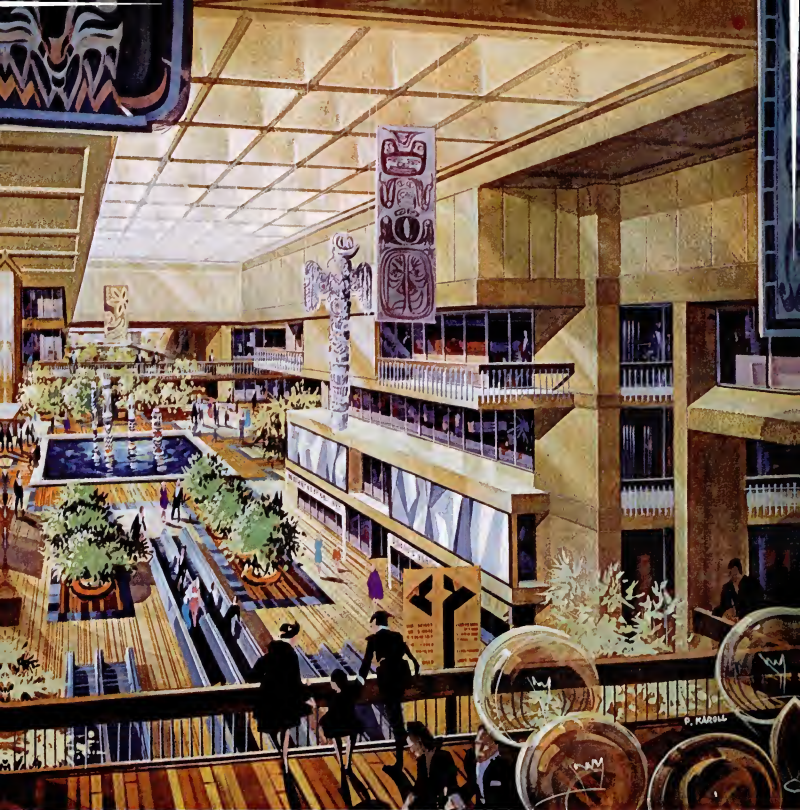
Appropriately, the first of the Seward's Success central buildings will be called the Alaskan Petroleum Center. Within it will be headquar-

tered many oil companies, banks, geological services, consulting agencies, and oil-field service companies. A hotel operated by a major chain will face the commercial mall.

Buildings that go up in the first phase of construction will cost \$170 million and provide living accommodation for the first 5,000 residents. There will also be 600,000 square feet of office space, 300,000 square feet of shops and restaurants, and a completely enclosed sports arena. Power for all of this will be generated on the site from abundant natural gas. Construction will go on all year, with warm-air-filled balloon tents enclosing the site during winter months.



Transportation from downtown Anchorage across Knik Arm, an inlet that separates Seward's Success from the Alaskan metropolis, will be by high-speed aerial tramway. Under the second phase of construction, the tramway will be supplemented by a monorail, which will circle the city, return to Anchorage, and then go on to the International Airport. Crossing Knik Arm via water is impractical because of the 21- to 34-foot tidal flow. Within the city, residents will get about on moving sidewalks, escalators, and bicycle paths. Automobiles will not be allowed inside the city; the tramway will carry residents to a garage area at Anchorage.



Commercial mall in Seward's Success is "spine" of the covered city. The moving sidewalks for shoppers and other pedestrians

(center) cover a rail system that is sunk beneath the mall. A hotel run by a major chain will front on the commercial plaza.

Home looks like this in glassed-in city. All housing units are interconnected around a residential plaza. Eventually, 40,000 people will be permanent residents of the all-new center

Rapid-transit trains like the one below provide intracity transportation. They'll link up with aerial tramway that runs on to Anchorage. Eventually, monorail will supplement tramway.





Plastic carvings to the rescue! Doors inside and out take on new distinction when you apply plastic carvings. The molded material can be finished to match wood.



BANISH DRABNESS!

New Beauty with

By DARRELL HUFF

When you use the remarkably woodlike moldings and carvings now available to rescue old or new doors, furniture, and built-ins from drabness, you're right in the trend of the times. The richness these adaptable newcomers bring to do-it-yourself improvements fits the spirit of modern American life.

With a selection of rectangular plaques, circular medallions, and straight and curved trim, you can convert a low-priced slab door into the equivalent of a costly carved one.

Combine the easy art of antiquing with these new carvings and you multiply the versatility of both. Any furniture or wood-work surface, however battered, takes on real charm when antiqued; and these molded carvings offer perfect texture for color contrasts produced by the antiquing process.

Plastic that looks like wood. Most of these products are cast from plastic materials chosen to give maximum fidelity to wood. They resemble wood originals closely in texture, feel, and appearance. They respond like wood to sawing, sanding, drilling, gluing, and nailing.

The carvings are so elaborate in themselves that restraint is called for in their use. Only rarely will you want to use more than two shapes in a single project, and often one is enough. Perhaps the most useful combination is narrow molding to form a border around a group of square or oblong plaques or round medallions.

Because the molding is made in a quarter-circle pattern as well as straight pieces, you can design borders that look surprisingly as if carved in place.

How to do the job. To cut the strip moldings to length, or to divide a medallion or plaque, use a hand or power saw. A fine-toothed blade will reduce or eliminate sanding.

Fasten the molding to the surface with any good wood glue.

Tired of looking at a piece of modern furniture? You can transform it into what looks like a period reproduction with some of the many decorative carvings that are available. Or, perhaps, start with unpainted furniture.



Decorative Carvings

Simply coat the back of the molding, position, then clamp or weight it heavily or secure it with a few small brads until the glue has set.

No special finishing techniques are called for. These carvings accept stains or paints much as wood does. In most cases, however, you'll want to use some kind of wiping technique to bring out the handsome lines of the carvings.

A most effective way to do this is with one of the antiquing products now in vogue. You can find a selection in most paint departments. Each type comes with its own instructions, but the basic procedure is uniform. Apply a base coat by brush, or spray it to the entire surface of both woodwork and carvings. Let it dry, then apply the glaze coat. Wipe this lightly while it is still tacky. How hard, how soon, and just where you wipe will determine the effect you get.

Some antiquing is more elaborate, calling for three or even four coats. The third coat is often gold, sparingly applied—an especially impressive treatment for carvings with fine detailing.

Antiquing materials may be obtained separately or in kits, which may include a clear finish coat. You'll need to give this additional protection

only to surfaces subject to considerable wear.

Where you get carvings. In most cases you can find decorative plastic carvings at local lumber yards, at building-supply houses, or perhaps in hardware stores. If you can't, the dealer should be able to order them.

All products shown on these pages were made by the Filon Division, Vistron Corp., 12333 South Van Ness Ave., Hawthorne, Calif. 90250. On the east coast, a leading manufacturer of similar products is Paeco, Inc., 500 Market Street, Perth Amboy, N.J. 08861. A brochure from this firm claims that its Instant Carvings molded from expanded urethane "not only look and feel like wood. They sound like wood."

What about price? Decorative carvings are not inexpensive. For example, Paeco lists a 24" length of 2½"-wide molding at \$1.99, a 6½"-diameter medallion at \$1.99, and a 10¾" by 22" rectangular plaque at \$5.99.

Molded carvings for use as described in this article are related to the false beams made for ceiling use. Paeco also makes beams. And these are just a beginning. Everyone concerned, in fact, predicts that products of simulated wood are entering an era of unimagined growth.

How you do the job: Any good wood glue can be used to cement chosen carvings in place where you want them. In the photo at left, below, panels are being applied to a plain old door. At right, a base coat is being applied to antique the door and carvings.



Installing Foam-Backed Panels in the Bathroom

What comes in colorful modern patterns, covers old bathroom walls (even tiled ones), stands up to moisture, and has seam-concealing moldings?

Answer: Formica's Panel System 202, a fine way to update an old bathroom—or even a modern bath you're tired of. Panels four or five feet wide come in lengths to 10 feet to fit between special moldings. The face is Formica ½" thick, backed by a ½" foam sheet that has enough give for smooth installation over tiles and other irregular walls.



Finished bath is a place of beauty. Note horizontal molding used to hide the panel joint above the tub.



This Starcraft truck camper carried editor Everett Ortner down Mexico way, and rolled up mileage from cactus country to the lush south...



Ford MiniHome at Grand Tetons dramatizes 2,100-mile test drive through five National Parks that's basis for report by editor Al Lees (in photos above). Based on the E-200 Super-Van, rig is under 16 feet long. Faired-in fiberglass dome gives six-foot-two headroom. Unusual galley, right, is across end of van, with cupboards above and below. Blocked rear doors still open to form semiprivate stall shower utilizing hose faucet from sink at right.



Gastron motor home was tested in Florida by PS writer Charles Meyer and family. Unlike smaller MiniHome, this 21-foot fiberglass motel-on-wheels sleeps five with ease. It's eight feet wide, on Dodge M-300 chassis.



We Hit the RV Trail!

To compare the merits of six types of camping vehicles, five PS editors and a regular contributor took off in separate rigs on camping trips covering 17,000 miles in the U.S. and Mexico. Their personal-use reports are on the next six pages





Posh Pad

Motor homes are the luxury "self-contained" among RVs. Here's how Glastron's rates

By CHARLES R. MEYER

We gave the new, 21-foot all-fiber-glass Glastron motor home an "acid test." Piling three infants aboard—two still in diapers—my wife and I took the rig for a 5,000-mile, month-long shakedown cruise. The unit endured 100-degree-plus temperatures, a spate of mountain climbing, some "off-the-highway" travel and camping, and all the depredation three active children could commit. "It wasn't a travel-folder type of trip," says my wife, Bambi, "but I'd pack up and go again any time."

Why? The sleek-looking Glastron

Lower Florida Keys provided trip's top fishing thrill. This 19-pound permit, taken at Sugar Loaf, made a family meal.

Two Mountain Weeks in a

Van conversions are the economy compacts of the motor-home category. Ford's entry is one of the best

By AL LEES / PS Home Workshop Editor

Perch a penthouse atop a standard van of the type used for city deliveries and you perk up its whole personality. The urban workhorse suddenly becomes a filly, eager to carry you to wide-open spaces. Build in a galley and sleeping accommodations and you've got one of the handiest portable homes in camping history. That's the key to the boom in van conversions, and after climbing all over a couple of rugged mountain ranges in one, I'm a convert from trailer travel.

Gypsying through western National Parks puts any camping vehicle through its paces. And when your campsites are as scattered as mine

were, you sample the extremes of driving conditions. When I wasn't going seven mph in low gear up some rutted track to an off-highway vista, I was hitting 70 across the flats of California valleys and Nevada desert. With any self-propelled RV, you must carry your home on your back wherever you roam, but this is no burden

when your home is in a compact van.

Ford's new MiniHome is typical of the breed—a conversion of the popular Econoline 200 SuperVan. To develop it, Ford joined forces with a company experienced in the RV field—PRF Industries, makers of Travco Family Wagons and Dodge Motor Homes. PRF, in turn, set up a separate divi-



Dinette-lounge seats four in comfort when forward seats swivel to rear. Above seats is storage bay. Table folds into wall recess.



Sleeps five? Nice try, but three beds are fabric slings on pipes that drop into wall sockets. Lounge unfolds to double bed.

for Family Safari



We Hit the RV Trail!

home, on a Dodge M-300 chassis with the big 318-cubic-inch V-8 212-hp engine, turned out to be a daisy. She is completely self-contained, thus eliminating the need for trailer-park hookups, except by preference.

With twin air conditioners, one in the truck chassis and the other top-side on the Glastron's roof, you're rigged for comfort even in a steaming desert. With a 22,000-BTU gas-vented, forced-air heater complete with a thermostat control, you'd be equally snug and cozy touring the Arctic.

First impressions. I was dubious about the motor home's roadworthiness. Perched up forward over the wheel, much like a bus driver, I missed the familiar automobile hood and engine up front. With a 21-foot vehicle, just short of eight feet wide and almost 10 feet tall, I was ridiculously cautious about hitting a bump in our driveway or brushing the gelcoat-paint side surface against a protruding tree limb.

This changed quickly. Before we'd completed the initial phase of our trip from eastern Long Island through

New York city traffic and south on the New Jersey Turnpike, I was crowding the speed limits and handling the big motor home like a VW.

Power steering, power brakes, and a Load Flite three-speed auto transmission are standard equipment on the new Glastron motor home. With all these conveniences, Bambi was able to drive with the same ease she feels in our station wagon at home. The problem was holding the rig under the 70-mph turnpike limits.

Wind slap. Driving any slab-sided vehicle with high superstructure, you learn to keep a firm hold on the wheel in gusty, high-velocity winds or when being passed by trailer or tanker trucks in close proximity. Actually, you feel as though you're being pushed sideways by a body blow.

Deliberately choosing a series of narrow, winding roads that undulated through foothills, I found the Glastron took the curves effortlessly but was rather slow on the steep grades.

"What would you expect?" asked Bambi. "With all our baggage, water

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Rear lounges of smartly styled living-dining room become a superb bedroom after dark. Fully equipped kitchen is at left.

What the Trip Cost

Overall, on our 5,000-mile, month-long round trip to Key West, we averaged between 10 and just under 12 mpg in the Glastron. Through personal choice, I stuck to premium grades. Total cost in gas and oil: \$200 to \$225. Add a few dollars for routine maintenance—oil changes, lubrication, checkups at the halfway mark and end of the month-long trip. With normal touring expenses, a family of five should budget maybe \$750 for a similar trip—going first class all the way.

MiniHome

sion, Motor Homes, Inc., with facilities near Ford's Lorain truck plant. MiniHomes are shipped from the plant in the same way unconverted Econolines are, and are sold only by Ford dealers.

Without benefit of check-out. My test-loan unit was assigned to me from a Hollywood parking garage, with no one on hand to check me out on its operation. In the glove compartment there was a fine owner's manual—on the Econoline. No instructions on the conversion itself. (Such a manual now exists; be sure your dealer sup-

[Continued on page 141]

What the Trip Cost

Total gasoline cost for the 2,100 miles was \$52.50—about 2½ cents a mile. I never needed a drop of oil, and there was no maintenance expense. National Park campgrounds are free, and I rarely paid over \$2 at private ones I used enroute, even with water and electrical hookups. To budget trip expenses, figure on spending a bit more than normal for groceries in camp stores.



Destination: Yellowstone. Riverside geyser erupts behind as author and van stay cool after long climb. At left rear of van, note

access door to butane tank; gas cap is to right of it, water hookup below, sink drain above bumper. Spare pivots downward.

South of the Border in a TRUCK

A slide-in camper on a pickup was our luxury home on a three-week Mexican ramble

By EVERETT H. ORTNER

Not even a 16-foot-long truck camper will hold all the serapes, sombreros, pottery, silver, glassware, and you-name-it that you can't *not* buy in Mexico, because, as your wife explains, when will you ever get the chance again to acquire such beautiful things at such low prices?

The logic being inarguable, our Starcraft truck camper slowly took on the interior aspect of a mobile gift shop as we rolled from native market to native market.

Although laden, eventually, like a camel bearing gifts from Solomon to the Queen of Sheba, our transportation performed heroically. Our 3/4-ton Ford Camper Special hauled us up, down, and in curlicues around the Sierra Madre Mountains with nev-



Bullfights are a must for tourists—but need a strong stomach. Author rooted for bull.



Native markets—like this one in Toluca—offer beautiful wares at low, low prices.

er a hint of strain and took straightaways at a happy lope. We found 60 mph a comfortable turnpike speed. On tight turns, however, the vehicle reminds you that it's not a sports car by wanting to travel in directions other than those you had in mind. Caution is the word here, as it is when you pass a bus or large truck and the wind blast followed by an after-passage vacuum make you hang on to the wheel tighter.

Mexican highways have comparatively little traffic, and the major north-south routes that we tried of-

fered fast, nonstop driving. Secondary roads—the ones that take you into such places as San Miguel de Allende, Taxco, and Guanajuato—are slower and take skill and care in driving. It's worth the effort. These old cities, unchanged from the days when the Spaniards ruled, are as beautiful as any in the world.

All the comforts. Our camper was a Starblazer 4 model made by the Starcraft Company (Goshen, Ind. 46526). Fitted out like a snug little yacht, it provided all the comforts of a modern

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New Space

A 21-foot travel trailer gave our family instant New England—with all the comforts

By DAVID D. VIGREN

Short on time for our family vacation, we decided to go long on comforts and conveniences. We chose the 21-foot Cimarron II travel trailer, made by Apache.

We had always been tent campers. Now the portable stove, ice chest, lantern, cots, and wash basins could be left behind. It resulted in the quickest, easiest vacation packing we'd ever done—and the least "work at vacationing" when we got there.

Our first treat was when we realized the spacious trailer, with all those built-in conveniences, was instantly ready to use wherever we stopped. At midday, on the way up to New Hampshire from our Long Island home, we casually pulled off the turn-

CAMPER



What's for supper? Lady of the house unloads the refrigerator. Dinette seats four.

What the Trip Cost

The charge for a night's stay in our camper ranged from nothing to a high of 25 pesos—\$2. Our Ford pickup with camper, over generally mountainous roads and frequently at high speeds, did 8.34 miles per gallon. It worked fine on regular gas in the U.S. but demanded premium in Mexico (about 40 cents a gallon). Our gas bill: \$115. Another big expense is special insurance for driving in Mexico: We paid about \$3.50 a day.



No alarm clock is needed in this farmyard at Ojuelos—roosters wake you up.

Program for Vacations

pike into a rest area and stepped into the trailer for lunch. Textolite table and cushy lounge seats were waiting for us; so was fresh food from the refrigerator. The Apache's insulation is so effective that we forgot to open the roof ventilator and turn on the fan until my wife suddenly spied them.

Road-handling was near perfect. We had selected a Reese Straight-Line

hitch, designed to equalize weight and resist sway. When it was joined to Apache's suspension system, I felt I was driving one vehicle, not two. The Cimarron II that I borrowed has wide-track tandem wheel pairs, independent wheel suspension, low center of gravity. Smooth and efficient Kelsey-Hayes electric brakes work with the car's brakes by foot pedal, or can

brake the trailer separately by fingertip control. This equipment team handled the hefty home-on-wheels better than any trailering I'd done.

Our rig easily managed the narrow roads twisting through the base of the mountains bordering big Lake Winnepesaukee (our first roost), and before sunset we found the trailer park. I was new at what I had to do. Approaching, then parking in hookup position in our campsite took caution, very slow speed, and an eye glued on the large, hood-mounted rear-view mirrors. It turned out to be easy.

[\[Continued on page 138\]](#)



We always had enough space for family living in the new Apache. Light, layout, and comforts made vacation more enjoyable.



Appliances and built-ins leave nothing to makeshift. Eye-level Magic Chef oven delighted my wife—we even got fresh biscuits.

What the Trip Cost

We averaged 10 mpg while pulling the 3,355-pound travel trailer, and spent \$38.90 for gas, nothing for oil or transmission fluid. Usual trip mileage in our Ford wagon with 390-cu.-in. engine is 13-14 mpg. Tolls were about 50 percent more with the trailer and came to \$8.30. Trailer-park fees in N.H. averaged \$3 per night (utilities included).



Equalizing hitch prevents Mercedes from being weighed down in rear. Here the rig is parked near an inlet at Acadia National Park, Me.



Pushbutton power raises the roof and front and rear walls of the Rolite folding camper. Side walls are raised manually, however.



Headroom is just about right for the author, shown leaving the camper. It's now fully set up for use, with ample family space.



Spacious dinette—a good place for a card game with author's children. A Norelco cassette player on the table sets the mood.

Trailing a Tent-on-Wheels

Our trailer packed plenty in a small box that quickly became a roomy tent house

By ERIK H. ARCTANDER

We stepped off a New York-to-Chicago plane and found our new International Travelall waiting. Only two hours after starting out, we had already covered 840 miles.

Dave Hartman and Rolf Blank of International Harvester showed us how to operate the big gold-colored wagon. Then we headed lickety-split for Hamilton—a Cincinnati suburb 295 miles away—to pick up our Nimrod tent camper at the factory. As I wheeled through heavy traffic and intricate cloverleafs to escape the airport, it struck me that this was really a small truck. Frankly, I wondered if I'd over-reached myself in choosing such a brute.

By the time we reached Hamilton,

all of us were delighted with the roomy vehicle. Her 235-hp V-8 had gobbled up the miles like a Greyhound bus. She had handled well, too, thanks to an automatic transmission, power steering, and power brakes. The kids were impressed by the air conditioner, my wife and I by our comfortable bucket seats as well.

Hello, Rabbit Hash. We mated a Nimrod Supreme to the Travelall late that afternoon and at dusk reached

River Ridge Park—a small trailer park in Rabbit Hash, Ky., overlooking the Ohio River. We backed into a spot and spent the next two hours in confusion. While my wife Rosemary read the instructions aloud by flashlight, the kids and I scurried around setting up our shelter. A family of skunks scurried around, too, under the trailer. We treated them with utmost respect. Who needs *that* kind of a christening?

Every tent-trailer buyer, we de-



Opened up, Nimrod Supreme had the space, convenience, and styling of a deluxe



travel trailer. Clever fold-down units (right) made the low towing profile possible.

Pushbutton Camping Comfort

Folding travel trailer sets up at the touch of a button, folds down for easy towing

By HERBERT SHULDINER

There's something uniquely sensible about a camping vehicle that combines the comfort and solid structure of a travel trailer with the towability of a tent trailer.

The Rolite folding travel trailer, which I used on a 3,000-mile trip last summer, provides this happy combination.

Although it's nearly three times as heavy as a tent trailer, the Rolite, at about 2,400 pounds, was a cinch to tow with the Mercedes 220 diesel I drove. The compact Mercedes' 65-hp engine pulled the Rolite along at turnpike speeds, yet averaged better than 20 miles per gallon of diesel fuel.

And though the fully loaded Rolite was a big package to hitch to this car,

it rode along in a very stable manner. Whether I was speeding along the Maine Turnpike or climbing curving mountain roads in Nova Scotia, I experienced no problems. The Rolite—only 54 inches high—is less than three inches lower than the Mercedes. But that helped in reducing resistance to headwinds.

In addition, there was virtually no sidesway when I passed tractor trailers or Greyhounds. Driving is a lot more relaxing if you don't have to worry about getting shoved all over the road when you pass larger vehicles.

You might expect these advantages in towing to rob you of some of the conveniences travel trailers give you when you arrive at your campsite—particularly the fact that travel trailers require no setup.

The manufacturer claims that the Rolite sets up in two minutes. I never became that proficient during my three weeks with the vehicle. In fact, the first night, at the Moin River National Forest in Maine, I struggled quite a while—raising the camper with one hand and holding the instruction

manual in the other. But it is not difficult. By the time we had pulled into Cape Breton National Park in Nova Scotia, I could raise the roof of this camper and set it up in 10 minutes.

Two buttons trigger a motor that raises and lowers the roof and front and rear walls. The motor runs on its own 12-volt battery. You run the roof up slightly higher than the top of the walls. The sidewalls go up manually, and are secured to the rear and front walls with eight sliding latches. Then you drop the roof a couple of inches onto the walls and the unit is snugly closed in against the cold and the rain you'll encounter sooner or later.

[Continued on page 138]

What the Trip Cost

Fuel was surprisingly inexpensive for this trip, with an average of better than 20 mpg of diesel fuel. The total was about \$60. Camping fees ran from \$1 per night at Acadia National Park to \$2 per night at Cape Breton National Park. Tolls came to exactly \$13. Food? About like at home.

Through Mid-America

cided, should have the dealer show him how to set it up and take it down.

On history's trail. We headed southeast toward Florida. Lexington's rolling horse country slowed us momentarily on the way to a new KOA campground near Lake Cumberland, just above the Tennessee border. The lake had boating only, but the campground's swimming pool served nicely.

Our next stop was Cedars of Lebanon State Park, east of Nashville. Driving through the city we saw no guitar-toting singers; but many classic-Greek buildings graced the hills.

The Hermitage, Andrew Jackson's old plantation outside Nashville, was a rustic charmer. Strolling under those ancient shade trees, exploring the houses, and reading "Old Hickory's" forthright letters gave us a vivid impression of the seventh president.

Civil War country. Then we were on the route Union armies had taken a century earlier—Lookout Mountain, Missionary Ridge, Chickamauga, Kennesaw Mountain, Atlanta. We

[Continued on page 152]



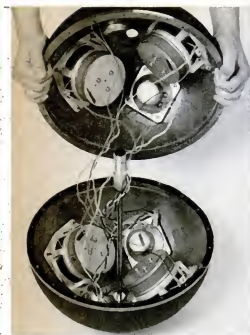
International's 235-hp Travelall, hitched to the Nimrod, made a great turnpike rig.

What the Trip Cost

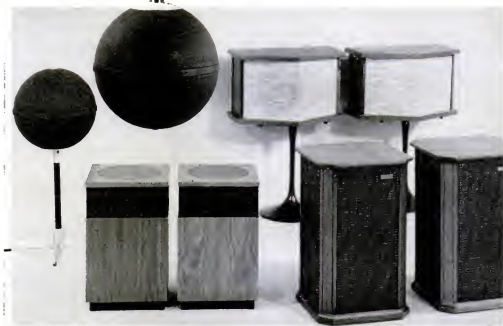
Food (four people, 12 days)	\$125
Gasoline (3,400 miles)	110
Tolls	14
Campsite fees (nine nights)	23
Entertainment (admissions)	16
Miscellaneous (ice, propane, hardware, gifts, etc.)	31
Total	\$319



We tucked the trailer into dense woods at Jekyll Island, unzipped its big windows.



Eight speakers (four woofers, four tweeters) angle sound in all directions from the inside of the JCV spherical metal enclosure.



SOUND ALL AROUND: The New



Woofer and tweeter (back left corner) in HK-50 fire sound upward against an aconic reflector. Sound is spread 360 degrees.

Base equalizer boosts bass to compensate for rolloff in wide-range speakers used in Bose 901 instead of woofers and tweeters.



These new speakers put your walls to work to give you exciting stereo perspective

By IVAN BERGER
PHOTOS BY ORLANDO GUERRA

Loudspeakers aren't just pouring sounds from their front panels any more. Instead, many of the newest designs are spraying their sound in all directions, splashing it against your walls.

The result, the manufacturers say, is to surround you with sound—and in the process, to bring you greater stereo depth, a wider choice of listening positions, and smoother, more even sound.

And sure enough, if you switch from conventional speakers to the new multidirectionals, the room will fill with more solid, more even stereo. (But not necessarily with *better* sound—that's a function of speaker quality, not type.)

The difference, though, is less dramatic than you may have been led to believe. That's not because the multis don't do what they are claimed to do, but because the conventional speakers do a better job than the multi makers give them credit for.

Sound by reflection. In the concert hall that's how most of the sound

reaches you, with only a small percentage coming directly from the performers. The same is true, as the ads point out, when you listen to multidirectional speakers in your home. But it also holds true for any speakers, provided that you sit more than four feet or so away from them.

Since the reflections that pervade the room come from both speakers, even conventional speakers let you hear at least some stereo almost anywhere in the room.

360-degree dispersion. How well you hear it away from your central listening position depends on your speaker's high-frequency dispersion. If your speaker beams its highs through a narrow angle, your optimum listening area will be limited. The ideal conventional speaker would have 180-degree dispersion at all treble and midrange frequencies (bass is omnidirectional no matter how the speaker is designed), and some of them approach this pretty closely. But multidirectionals do even better—up to 360 degrees.

And this has three effects:

First, it enlarges the area in which you can re-create the stereo image from direct speaker sounds.

Second, it increases the ratio of reflected to direct sound in the room, because speakers facing away from you are heard only by reflection.

Third, it distributes these reflections throughout the room, so they



Nine wide-range speakers, only one of which faces the listener, are used with Bose 901. Unlike other speakers shown, the



Bose does not project sound 360 degrees. Instead, it disperses sound by bouncing it off the wall behind it. It should be placed

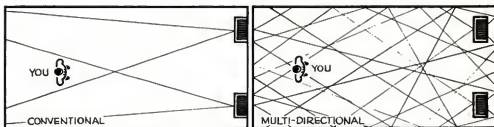
with the bank of eight speakers facing the wall, and about 18 inches away from the wall. Grille cloth is removed in photos.

Multi-Directional Speakers

seem to reach you from more directions. This would seem to be the main reason for the multidirectional's effect.

By now, there are dozens of speaker systems, consoles, and compact phonographs embodying multidirectional techniques (see chart), with more sure to come. And the listening experience they can provide is rich and pleasant—if the sound itself is

Continued



Theory behind the multis is demonstrated in sound-wave diagrams. Optimum stereo listening area with conventional speakers is

indicated by triangle around subject (left). Dispersed sound of multis (right) expands listening area to cover almost entire room.

Listener's report: PS tests four of the new multi-directionals for you

I listened to four new high-quality multidirectional systems—the Scott Quadrant Q-100, the JCV 5303, the Harmon-Kardon HK-50, and the Bose 901—for several weeks in my living room. They're shown in the picture on the facing page. They all work on different principles, and they all sound different.

The Scott Quadrant Q-100 is the most obvious design. One midrange/tweeter unit fires out of each of its four sides, with woofers on two sides (no more are needed since low frequencies are omnidirectional). The Q-100 sounded smooth, pleasant, and unobtrusive. The bass rolled off cleanly with no apparent doubling or distortion. It compares quite favorably with many conventional speakers in its price class.

The JCV 5303 takes omnidirectionality a bit further. Its eight speakers (four woofers, four tweeters) angle up and down as well as to all sides from the surface of its spherical metal enclosure. The 5303 sounded very clean and clear, but below 200 Hz. its bass response rolled off at about six db. per octave. Boosting the bass controls on

my amplifier brought out some rich, taut bass but boosted the midrange frequencies, too. Some listeners might prefer the extra "presence" the boosted midrange adds to solo performances.

The Harmon-Kardon HK-50 takes a different approach. Its single woofer and tweeter fire upwards into a conical reflector, which in turn disperses the sound outward to all points of the compass.

Because the woofer and tweeter are mounted asymmetrically within the speaker enclosure, the reflector is asymmetric, too. This puts a bit more treble in the corner where the tweeter is, so you can orient the speakers for the tonal balance that suits you best.

The HK-50s, though nicely styled for floor use, looked good when shelf-mounted, too. In fact, they sounded best when raised off the floor. In general, the sound was pleasant, though it had a slight nasality common to many speakers in its price range.

The Bose 901 was the most expensive of the speakers that we tested. Only one of

its nine speakers faces the listener, and none faces to the sides. The remaining eight are angled toward the wall, which serves as a reflector. The point of the pentagonal enclosure should face the wall from a distance of 12 to 18 inches for flattest sound. The exact distance is fairly critical, but seems to vary from room to room.

The sonic perspective was different from that of the other speakers tested, and more natural, with the sound source seeming to fill a solid area at the speaker end of the room.

The sound was rich and spacious. The bass was impressive down to very low frequencies, though not as undistorted as that of the AR-3a that I used as a reference speaker. But, as with most speakers in this price and quality range, differences are subtle, and final evaluations subjective. A speaker that sounds just right to me may not be as pleasing to your ears. A PS editor listening to the same tests with me preferred the Bose's sound to that of the AR.—Ivan Berger.

clean and flat, with no distortion.

But don't be overwhelmed by the stereo effects these new systems can produce. Before you buy one, listen carefully—not just for enriched stereo perspective, but for all the other sound

qualities you'd demand of conventional systems with less spectacular stereo effects. For if a multidirectional system sounds bad, it will do a good job of distributing that bad sound throughout your room. **ES**

A MULTIDIRECTIONAL DIRECTORY

SPEAKER SYSTEMS

Make	Model	Price	Type
Bose	901	\$476 per pair, including equalizer	Wall imaging type; eight speakers facing wall, one facing listener. Sold only as pair, with equalizer to compensate for high frequencies absorbed by wall.
Epi	Tower	\$1,000	Outward-firing type; 6'6" tower with woofers, tweeters on all four sides.
	Quartet 201	\$199	Self-dispersing type; woofer and tweeter module with 180° claimed dispersion firing upward; additional module faces forward.
Harman-Kardon	HK-50	\$100	Cone reflector type; woofer and tweeter fire upward into asymmetrical reflector.
	HK-25	\$70	Same, with single speaker, symmetrical cone reflector.
	HK-12	\$45	Same.
	Citation	\$250	Self-dispersing type; upward-firing, 180°-rated speakers, no reflectors.
JVC	5303	\$200	Outward-firing; spherical enclosure.
Martin	Prismatic Reflector	\$300	Wall-imaging type; movable, internal reflectors direct sound where needed.
Pioneer	CS-03	\$125	Cone reflector type; delivery February or March.
Realistic	40-1975	\$19.95	Cone reflector type.
H. H. Scott	Q-101	\$240	Outward-firing; speakers on four sides.
	Q-100	\$150	Outward-firing; speakers on four sides.
	Q-102	\$80	Outward-firing; speakers on three sides (for shelf mounting).
Wharfedale	Variflex W80	\$290	Wall-imaging; movable, internal reflectors direct sound where needed.

COMPLETE SYSTEMS

Electro-Voice	Landmark 100	\$400	Compact phono with AM, FM. Outward-firing speakers controlled by feedback connection with amplifier. Amplifier response contoured to equalize speaker response.
Electro-Phonic	2760, 2759	\$400	Compact phono with AM, FM; inverted-cone reflector speakers.
	TG-2773	\$250	Compact phono with AM, FM, eight-track tape cartr. player; inverted-cone refl. speakers.
	G2752	\$200	Same, without eight-track.
	G1052	\$180	Same, but phono only.
Harman-Kardon	SC 750	\$530	Compact phono with AM, FM; uses Harman-Kardon HK-50 speakers (see above).
	SC 2550	\$500	Compact phono with AM, FM; HK-50 speakers.
	SC 2525B	\$470	Same, with HK-25 speakers.
	SC 2350	\$400	Compact phono with AM, FM; HK-50 speakers.
	SC 2325	\$380	Same, with HK-25 speakers.
	SL 1312	\$350	Slimline FM-AM receiver with phono changer, cassette recorder; HK-12 speakers.
	SC 1825	\$300	Compact phono with FM; HK-25 speakers.
	SC 1812	\$260	Same, with HK-12 speakers.
	SL 112	\$250	Same as 1312, less cassette recorder.
	SC 1512	\$220	Compact phono; HK-12 speakers.
Major	SL 1012	\$200	Same as 1312, less cassette and phono.
	Futura	\$70	Compact phono; inverted-cone reflector speakers.
RCA	Dimensia IV	(dealer-set)	Compact phono; inverted-cone reflector speakers.
H. H. Scott	Salem	\$1,000	Console phono with AM, FM (tape optional); outward-firing speakers in sides and front.
	Andover	\$700	Console phono with AM, FM (tape optional); outward-firing speakers on sides and front.
	Carlisle	\$600	Console phono with AM, FM.
	2507	\$540	Compact phono with AM, FM; Q-100 speakers.
	2506	\$500	Same, with less expensive changer.
	2505	\$480	Same, with less expensive changer.
Zenith	Z590W Troubadour	\$280	Compact phono with AM, FM; inverted-cone reflector speakers.
	A589W Impromptu	\$240	Compact phono with AM, FM; inverted-cone reflector speakers.
	Z565W Moderne	\$200	Compact phono; inverted-cone speakers.
	A564W Artiste	\$170	Compact phono; inverted-cone speakers.
	A448W Whirlaway	\$170	AM-FM stereo table radio; built-in, inverted-cone reflector speakers.

Now—



To raise and lower blade, turn knob on the motor housing. Wingnut on side of blade guard locks the setting.



Arm swivels for miter-cutting. Tapered, spring-loaded locking pin provides automatic settings at 0 and 45 degrees.



On-off switch is a rocker type. It locks off by means of a special key to prevent unauthorized use of the saw.



Crosscut capacity is 10½ inches, which left me wishing they had gone a bit further to cross a one-by-twelve.

a Precision \$100 RADIAL-ARM SAW

Plenty of power in a slick compact size makes this new saw ideal for small workshops

By R. J. DeCRISTORORO

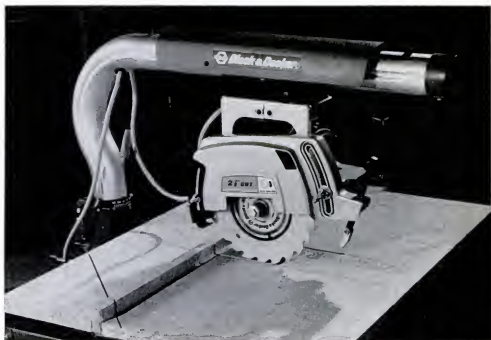
Black & Decker's new radial-arm saw makes a lot of sense. I used it, and was impressed. It gives you big-saw power in a compact size that will fit any shop or even follow you to the job. It will make precision miters, crosscuts, rips, and bevel cuts. It will also swing a six-inch dado head $1\frac{3}{16}$ inch wide. The price is a compact \$99.95.

The new saw stands up to its big brothers as an eight-inch tabletop saw does to a heavy 10-inch floor model. There's less sophistication and capacity, but I'm happy to say little brother was born with muscle equal to two hp. This strength plus a no-load speed of 5,200 rpm produces nice cuts whether you're working with standard eight-inch blade, smaller ones, or with the six-inch dado head.

It's a sawing machine. This radial-arm saw is not a one-tool shop. It's made for sawing. You'll find no sanding, shaping, or drilling items on the accessory lists. And since the blade guard is a fixed part of the power unit, the saw seems an unlikely candidate for such accessories in the future.

Adjustments. A rack-like affair at the rear of the guard is activated by a knob-turned gear that raises and lowers the motor and blade about a pivot at the front end. This is a lot like the depth-of-cut adjustments you'll find on portable cut-off saws. It's simple, but it works fine, and you can't argue with that.

This arrangement eliminates the need to raise and lower the arm itself,



so here we have a one-piece heavy-steel, swan-neck steel tube that has nothing to do but swivel for the miter-cut settings.

Controls at the base. It does that like any other radial except that the controls are located at the base of the arm, which is, of course, at the back of the table. Needless to say, the machine should be turned off when you make miter adjustments.

Stops are provided for automatic locking at commonly used settings. The spring-loaded miter-locating pin has a tapered end that slips into slots in the arm-retaining casting. It's possible to be too casual when relying on it, so you soon learn to coax a little by nudging the arms back and forth a bit until the pin seats snugly. The owner's manual (which is a good one) is very specific about how to set the stops, how to use them, and how to check them periodically to maintain their accuracy.

The tool weighs only 58 pounds, so even if you mount it on the steel accessory stand it's really portable.

Get acquainted. You should spend a few hours setting the saw up for use; it doesn't fall into the "ready-to-plug-in" category. I don't object to this. Assembling the bottom structure, bolting down the base casting, adding and leveling the table—these chores will help you understand the machine. And once you get to know the saw, or any tool for that matter, you'll find you can do better work with it, in less time, and with less effort.

If you want a basic sawing machine that will fit a small shop and still cut with the authority of a full-size saw; if you want a radial so light you can take it out on construction jobs; if you are a happy table-saw man but want the advantage of a second saw for certain types of cutting, then the Black & Decker compact radial-arm saw is an economical way to go. **■**



Depth-of-cut—2 $\frac{3}{4}$ inches—is impressive for a small saw, especially since the motor has plenty of power to back it up.



You run out of table and room when you swing left for a 45-degree miter (above), but you can help yourself by using pro-



cedure shown in photo at right. Make a multi-piece table for the rear by cutting up some scrap $\frac{3}{4}$ -inch plywood.



O'Dome instant home can be erected in half a day, says its manufacturer. It is 26 feet in diameter and encloses 530 square feet.

VACATION HOMES

Assemble it yourself or just move in—your instant home is delivered to your site in any form you choose

"Please send me one vacation home, Model X, complete with..."

Buying by mail is an increasingly popular way of becoming one of America's second-home owners, already nearly two million strong. This figure, double that at the opening of the decade, should increase by 300,000 more in the next two years, according to intentions confided to the Bureau of the Census.

Why acquire a leisure home? Two motives make sense in the Seventies: In an increasingly crowded world, privacy and quiet are luxuries not easily come by in any other way. And buying a second home is just about

the only way a family can spend money for fun—and get it all back.

With land and building costs running a nose ahead in the inflation race, there is reason to believe that your leisure home, and especially the land you put it on, will be worth more tomorrow than it will cost you today. So even the thrifty find appeal in a second-home purchase. Vacation money put into a down payment is not money gone forever.

Buying by mail simplifies the second-home purchase. You know precisely what you are getting, and at what cost, before you commit your money. In the case of many models,

Continued



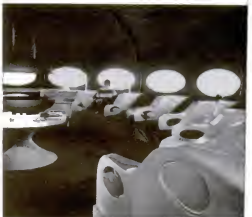
The Futuro, above, looks like a flying saucer and it actually can be flown to your home-site fully assembled, if you wish. The colorful shell (in blue, green, lemon, or white) is made of 16 pieces, and a total of 704 pieces provides built-in furnishings. The 8,000-pound fiberglass structure is 26 feet in diameter with 500 square feet of living space. Interior (below) has a barbecue-fireplace that is part of the central air conditioning. The Futuro sleeps eight. Cost of shell, \$10,000; \$14,000 equipped.



Universal Papertech's 800 model looks as if it's made of something more substantial than paper. But the "Unikraft" material used to construct this home is a stout building board that beats wood in its resistance to fire and water. Weather protection is supplied by coating the structure with fiberglass and an already pigmented polyester resin.



Spacemakers 600 uses popular mansard style that removes the one drawback of A-frame design. By chopping off the top of the tall A, for a mansard roof, you get walls that slope so gradually there is no loss of headroom. And there is no waste space or heat trap at the top. The 600 is 24 by 28 feet and has one bedroom on each floor.





Spacemaker's design blends Swiss Chalet and New England traditional into something trim and modern. Saltbox roof effects blend without loss of integrity. Compact house retains informality wanted in a leisure home. Living and dining areas are two stories high. Kitchen, bedroom, bath, and utility space are tucked under two upstairs bedrooms and second bath.



Swift home is one of increasingly popular A-frame designs. Nearly half of the second-home manufacturers offer A-frames. Houses like this go up fast and call for fewer skills. The swooping roof sheds water and snow and—unlike many sidings—never needs painting. The simple Swift A-frame encloses a remarkable amount of space for the money, although not all of it is easily usable.

YOU BUY BY MAIL

By DARRELL HUFF



The Designaire (above) is a "turn key" prefab. That means that it's ready to live in as soon as it's set up on your site. It comes to you complete with wiring, plumbing, installed kitchen, electric baseboard heat, and even carpeting. This model can be erected and made ready for occupancy by a four-man crew in two days. Each separate wing is delivered on a specially designed trailer truck (below), and a crane places it on the prepared foundation. Designaire homes are made with two to four bedrooms.



Frontier I vacation home has barnlike flavor with its rustic use of saw-textured redwood. It needs no painting or staining of interior walls (below), and very little trim. For economy in shipping, the model is precut, rather than prebuilt. Wiring and plumbing (except for fiberglass tub/shower that must be put in place during erection) are not included. The house is designed for easy building where skilled help may be hard to find. Detailed drawings are supplied to simplify erection of the home.



Vermont Log Buildings model (above) is one of a dozen models offered by the firm. It has the nostalgic charm of a real log cabin and promises that "getting away from it all" feeling as no other kind of second home can—and you don't have to wield an axe to claim the promise. The home has prehung windows and exterior doors. The spacious interior (below) can accommodate up to five bedrooms for big families or large-scale entertaining. This is the firm's largest and most expensive home: \$7,293.



PS Buyers' Guide tells you what's available in vacation homes and where to write

PS Buyers' Guide to Vacation Homes	MAKER	PRIMARY AREA	ARCHITECTURAL STYLES OFFERED					FORM OFFERED				TYPICAL PRICES	REMARKS	
			A-frame	Seacoast/ Barn	Chalet	Modern	Traditional	Custom	Builder-erected		Owner-erected			
									Shell	Finished	Shell			Finished
			CONSTRUCTION											
Acorn Structures Inc., Box 540, Concord, Mass. 01742	Northeast U.S.		x	x	x		wood frame, plywood	x	x			\$7,492-\$34,953	Wide selection of handsomely detailed "contemporary houses with fresh and friendly New England character"	
			x							x		\$4,950	"Nutshell"—tiny (8'x18') complete house that later can become the core of a 20'x48' version	
Air-Lock Log Co., Inc., P.O. Box 1073, Prescott, Ariz. 86301	all U.S.				x		hollowed logs					\$2,425-\$4,115	Package includes only framing and walls: lathe-turned and tongued and grooved	
					x		hollowed logs			x		\$572-\$2,349	Rectangular "Mini Cabin"—precut for do-it-yourselfers	
American Timber Homes, Inc., Escanaba, Mich. 49829	East, Central U.S.	x	x	x	x	x	solid cedar walls			x	x	\$3,242-\$30,786	Handled by distributors in 12 states, all-year homes include everything except masonry and floor framing	
Boise Cascade Timber Product—Union Lumber Region, 90 W. Redwood Ave., Fort Bragg, N.C. 95437			x	x	x		rough redwood walls		x			\$3,920-\$8,926	Two to four bedrooms, all with wide decks. Having houses erected and interior finished will approximately double shell cost	
Burkin Homes Corp., White Pigeon, Mich. 49099			x				cedar shakes		x			\$5,562-\$16,342	Factory prebuilt, towed to site, set up and completely finished and furnished in a few hours	
Continental Homes, Inc., Box 1800, Roanoke, Va.	most of U.S.				x	x	siding or shingle			x		\$12,000	Modular sections trailered in; plumbed and wired for completion in a few days	
Continental Homes of New England, Inc., Nashua, N.H.				x	x	x	wood frame	x	x			\$2,488-\$11,280	Paneled and sold as do-it-yourself package or erected for you on a pier foundation	
Deck House, Inc., 930 Main St., Acton, Mass. 01720	Eastern U.S.			x	x		post-and-beam	x	x	x		\$9,400-\$68,300	Handsome detailed contemporary designs; models open in four Eastern cities	
Designaire Home Corp., 65 E. Northfield Rd., Livingston, N.J. 07039			x	x	x		rough-sawn redwood		x			\$12,000-\$37,500	Factory-manufactured modules hauled to site, erected, and ready for occupancy in two weeks	
Futuro Corp., 1900 Rittenhouse Sq., Philadelphia, Pa. 19103	U.S. and Caribbean						squat fiberglass globe	x				\$10,000-\$14,000	Flying saucer house, furnished and carpeted, may arrive by truck, barge, or helicopter	
Grossman's Quality Homes, 200 Union St., Braintree, Mass. 02184		x	x	x	x		wood frame		x	x		\$3,550-\$5,995	Complete packages for "three-season living," with options for winterizing	
						x	paneled wood frame			x		\$2,500	"Red-Built" 20'x28' cabin paneled for one-day erection by owner	
International Homes of Cedar, Box 3074, Seattle 98114	nationwide					x	3" cedar timbers					\$6-\$7 sq. ft.	Engineered and precut to your design from t&g notched timbers	
James River Building Supply Co., P.O. Box 217, Sandston, Va. 23150							factory-built modules			x		typical: \$8,500	Four types of units that can be combined in 432 ways for tiny cabin or large vacation house	
Jim Walter Corp., P.O. Box 9128, Tampa, Fla. 33607	Md. to Ariz.				x		wood frame	x	x	x		\$2,500-\$10,000	Will erect shell or finished house on your lot anywhere	
Justus Co., Inc., 2116 Taylor Way, Tacoma, Wash. 98421	nationwide	x	x	x	x		Western red cedar			x		\$2,100-\$16,000	Engineered for amateur or professional erection, houses have 3" or 4" double t&g walls	
Kingsberry Homes, Boise-Cascade Corp., 61 Princeton Park E., Atlanta, Ga. 30341	Eastern U.S.			x	x		rustic rough redwood	x	x			\$5,000-\$20,000	One- to three-bedroom vacation houses, distinctively detailed—all with decks	
Lindal Cedar Homes, 9004 S. 19 St., Tacoma, Wash. 98465; 8400 Willard Ave., S. Burnaby, B.C.		x	x	x	x		cedar plank	x	x			\$615-\$14,915	Parts factory-cut and numbered for contractor or do-it-yourself erection	
Manufactured Homes of California, Box 61, Healdsburg, Cal. 95448	worldwide	x	x	x	x	x	rough redwood			x			You erect subfloor, supply four-man crew, and factory expert shows you how to close in house in two days	
Maryland Housing Corp., 5820 Southwestern Blvd., Baltimore, Md. 21227	Md., Del., Va., W. Va., Pa.		x	x			wood siding	x	x	x		\$12,000-\$20,000	Owner or local contractor may erect or maker will provide crew	
Modular Component Structures, Inc., 809 G St., Chula Vista, Cal. 92010		x	x	x	x	x	panels assembled from 2" lumber					\$2,195 up	Components for any style and plan you like factory-built and color-coded for fast assembly	
Morgan Portable Building Corp., 6100 N. Central Expwy, Dallas, Tex. 75235	most of U.S.				x		aluminum siding		x		moderate		Portable lake cottages arrive complete, may be moved again at any time	
Northern Homes, Inc., 10 LaCrosse St., Hudson Falls, N.Y. 12839	Northeast U.S.			x	x		frame, handsplit shakes					typical: \$6,452	Paneled house arrives with complete instructions for you or your builder	
Nor-Wes Trading Ltd., 1075 Marine Dr., N. Vancouver, B.C.	worldwide	x	x	x								\$2,459-\$13,494	Specialty is cedar chalets, precut and detailed for rapid erection	
Pan-Abode Inc., Renton, Wash. 98055; Box 65, Windsor, Cal. 95492					x	x	cedar timbers			x		\$12,125	Construction of notched t&g timbers gives effect and construction ease of a log cabin	
Pleasant Homes, 4100 Broadway, Eureka, Ca. 95501	Far West	x					rough-sawn redwood			x		\$8,636	Offered as shell for owner erection or with extras for finishing interior	
Pritchard Products Corp., 4625 Roanoke Pkwy., Kansas City, Mo. 64112	nationwide	x	x	x	x		redwood log siding	x	x		moderate		Paneled construction for faster erection by builder or owner	
Rite-Craft Manufactured Homes, P.O. Box 400, Shamokin, Pa. 17872	Eastern U.S. south to Va.					x	aluminum siding			x		\$7,000-\$10,000	Standard package is complete house; options include fireplace, furniture	
Spacemakers, 146 Will Dr., Canton, Mass. 02021	Eastern U.S.	x	x	x	x	x	redwood siding	x	x	x		\$6,565 up	Company (subsidiary of International Paper) offers engineering aid to do-it-yourselfers	
Stanmar Inc., Boston Post Rd., Sudbury, Mass. 01776		x	x	x	x		cedar or mahogany		x			\$7,568-\$29,584	Offers "total service" planning, materials, construction, financing	
Swift Homes, 241 Curry Hollow Rd., Pittsburgh, Pa. 15236	east of Miss.						wood siding and shingles	x	x	x		\$4,000-\$9,000	In addition to shell, interior-trim and finishing packages are available	
Techbuilt, Inc., Waltham, Mass. 02154		x	x	x	x		plywood siding					\$10,000-\$27,000	Erected by builder representatives	
Tension Structures, Inc., 419 E. Main St., Milan, Mich. 48160				x			colorful laminated fiberboard		x			\$2,650	O'DOME—26' round temporary or permanent shelter for one-day assembly by two men	
Universal PaperTech Corp., Hatfield Industrial Park, Hatfield, Pa. 19440	nationwide	x		x			fiberglass, resin coating					\$895-\$2,665	"Unikraft" building board gives fast erection, low cost, can be coated to become masonry structure	
Vacation Land Cabin Co., P.O. Box 292, Bellaire, Mich. 49615	nationwide	x	x	x	x		half-log or plank	x	x	x		\$1,374-\$11,493	Delivered by factory truck in semifactured or component form for easy completion	
Vermont Log Buildings, Inc., Hartland, Vt. 05048	Eastern States						peeled pine logs					\$2,955-\$7,293	Real rustic log sets, all precut, notched, and splined	
Ward Cabin Co., P.O. Box 72, Houlton, Me. 04730		x		x	x		Northern white cedar logs					\$1,500-\$15,750	Cut, notched, and preservative-treated logs average 4 1/4" thick	
Weston Homes Inc., P.O. Box 126, Rothschild, Wis. 54474		x					rough board-and-batten			x		\$5,750	Price is for 24'x28' house including interior materials but not foundation and erection	

for more information

you can almost instantly have your new home—all ready for a vacation in the same summer, often the same month in which you buy it.

If for reasons of both fun and economy you'd rather build your own house, you can buy it in bits and pieces, but with all parts precut to speed the job.

If your carpentry ambitions are more modest, you can order a shell, have it erected, then go on to finish it yourself. You won't save as much, of course, but the difference can still be several thousand dollars.

The first big step toward buying a second home is to determine just what is included in the price.

What do you get? As you can tell from the chart, some manufacturers offer minimum shells—perhaps no more than wall materials and roof framing. Most, however, include doors, windows, roofs, and often partitions. Some makers include cabinetwork and even plumbing, wiring, and heating and cooking equipment. A few offer ready-to-live ins, complete with built-in furniture and carpeting.

It's important to watch this aspect when making your price comparisons.

The question of style. This may be very important to you. A vacation house is for fun, and what looks like fun is very much a personal matter. If you crave something that looks like a flying saucer, you can have it. Equally easy to find is a chalet cunningly contrived to look like something crafted by an elf in the Black Forest.

You may find maximum relaxation in making the greatest possible change when you get away to your weekend home. Living regularly in a city apartment or a suburban modern home, you might enjoy a rustic log cabin most of all.

Nearly all the leisure homes shown and described here are suited for year-round living or are readily adaptable. Those not fully insulated can usually be had with optional four-seasons treatment.

Requirements for leisure and retirement homes overlap. Many buyers find it good strategy to consider both needs when buying, even though full retirement is far, far away.

The photographs provide a sampling of the principal types available. The chart pins down some of the details, provides a quick index to find what you're seeking, and lists manufacturers to which you can write for literature. [E]



TV star Glen Campbell plays the new parabolic-back guitar.

Science Builds a Guitar with the Now Sound

Taking the vibration out of copters helped to design a new "well-rounded" guitar

By PAUL WAHL

Guitars and helicopters have a common problem—the control of vibration. Guitars need quality vibration to make music. In helicopters, vibration makes trouble. The Kaman Corp. spent years and millions taking vibrations out of whirlybirds. Recently Charles H. Kaman, president of the firm and an accomplished amateur guitarist, reasoned that they might use this hard-won know-how to design a better guitar.

Not much had been done to change the acoustic (non-electric) guitar since about 1550. After extensive acoustic testing and comparison of almost every kind of antique and contemporary guitar plus more than 70 of their own original designs, Kaman engineers decided that the most efficient shape for a guitar sounding box is actually a semi-parabolic bowl—something like an orchestra shell.

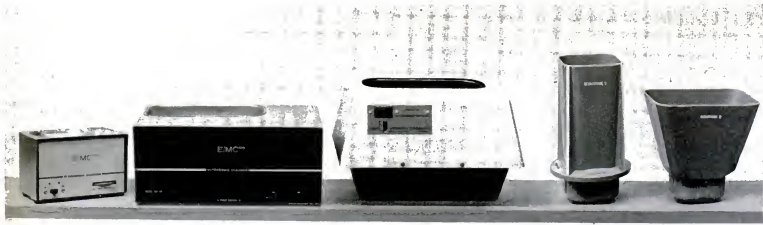
The rounded bowl reflects sound

better than the flat back of conventional guitars. Roundback sound is measurably fuller, richer, deeper, and more constant from top to bottom of the scale.

Having found the ideal shape, the engineers next had to find the ideal material. Wood wouldn't do. Made thin enough to vibrate at its best, the wood of a bowl would be impractically fragile, even with undesirable sound-baffling internal braces and reinforcing members. After many trials, they invented "Lyrachord."

Related to other lightweight laminar substances Kaman had perfected for copter rotors and other aerospace components, "Lyrachord" is an omnidirectional silicone fiber bonded with resins. Virtually indestructible, it can be precision-molded to any shape. "Lyrachord" has a smooth, highly sound-reflectant surface with uniform vibrating characteristics. Its molecular structure can be precisely "tuned" chemically and thermally to the desired resonance.

Thus imaginative application of today's aerospace technology to the age-old craft of the luthier has built a better guitar—the first really new acoustic design of this sort in more than 400 years.



Units tried: E/MC® Model LP-2, E/MC® BP-1, Crest 100 (also sold as Bausch and Lomb Balsonic 1), two tanks for Branson Ultrasonic

Put Sound Waves to Work in

These ultrasonic cleaners remove dirt you can't see, using sound you can't hear

By PAUL WAHL

A quiet revolution in household cleaning is under way. Hundreds of the time-consuming scrubbing jobs around the house and shop can now be performed by ultrasonic waves.

The ultrasonic cleaner, widely used by industry for the past 20 years, has at last become a home appliance. With recent technological breakthroughs, the electronic innards can now be made cheaply enough to go in a modestly priced consumer product.

Today you can buy one of these handy gadgets for as little as \$39.95. I found a half-dozen models on the market that are right in size and price for home and shop use.

What will they clean? Just about anything hard or semi-hard that will fit in the tank. With appropriate chemistry (detergent and water for most jobs), they will remove dirt, grease, rust, loosely adhering coatings, etc.—usually in about a minute.

I used mine to clean electric shaver heads, paintbrushes, jewelry, coins and medals, brass cartridge cases for reloading, and a lot of very dirty small tools. In every instance, the ultrasonics did the job faster and better than I could ever do it with the same cleaning solution and a rag or brush.

How do they work? Two elements are responsible for the ultrasonic vi-

brations: an electronic oscillator that converts current to a particular resonant frequency; and a transducer, a ceramic crystal under the cleaning tank, that turns the electrical excitation into sound waves. The sound waves are transmitted to the cleaning fluid, and millions of tiny bubbles begin to form, then implode. As the solution rushes in to fill the tiny vacuums, the motion produces a cleaning action like that of millions of tiny scrub brushes.

The range of ultrasonic cleaning frequencies is from 20,000 to 90,000 Hz., well above the range of human hearing. The higher frequencies generate small bubbles that can penetrate the littlest crevices. Frequencies around 20,000 produce larger bubbles that remove heavy incrustations faster, but are less effective in small



In the shop, the ultrasonics go to work cleaning small tools, machine parts, paintbrushes—anything you can fit in the tank.

With special-formula cleaning agents, the ultrasonic cleaners can make quick work of the cleaning and polishing of silver.





Deluxe (above, left) and the Bransonic 12.

Your Shop

crevices. Smaller bubbles can remove heavy soil, too—it just takes them longer.

Of the units I used, the Bransons operate at near midrange frequency, (55,000 Hz.) while the two E/MC² units run at the high end. Crest features "simultaneous multi-frequency" from the top to the bottom of the range. All the machines performed well for me.

The cleaning fluid. Since it's the solution that does the cleaning—the sound waves do the "scrubbing"—it must be matched to the job. For most jobs you can get good results with ordinary household detergents. Enzyme-action products seem to work best on organic dirt. Automatic dishwasher detergents should not be used; their foam suppressants kill the bubbling action.

Proper cleaning agents for rust and other metal oxides are available from the makers of the ultrasonic cleaners.

How long does it take to clean something ultrasonically? That depends on the unit, the cleaning agent, and the nature of the soil to be removed. I found it's usually 30 seconds to five minutes.

Before you buy your cleaner, make sure the tank is the right size for the jobs you have in mind. You can check that, and other points, by writing to the makers: Bransonic (Branson Instruments, Box 768, Shelton, Conn. 06484); E/CMC² (Electromotion Components, 11 Lincoln St., Copiague, N.Y. 11726; or Edmund Scientific, Barrington, N.J. 08007); Crest (Crest Ultrasonics, Scotch Rd., Mercer County Airport, Trenton, N.J. 08628).

Oh, yeah—the things make great mixed drinks, too. Wait till you taste your first ultrasonic martini!

Who Needs a Motorcycle Battery?

Wire in this capacitor and you ride without one

By JIM DAVIS

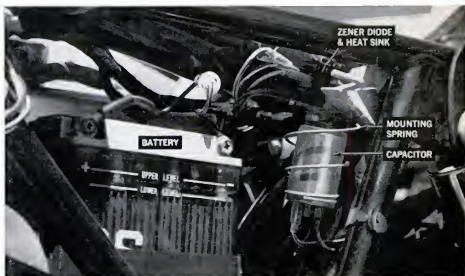
Want to leave the battery home when you ride enduros or scrambles? Or start your street bike even if the battery goes dead? Wire in a capacitor. It accumulates pulses of DC electricity from the rectifier and supplies steady high-amperage current for the ignition and lights.

Adding a Lucas 2MC capacitor is easiest on late-model British machines with Lucas electrics. Older British bikes will need a larger heat sink to avoid burning out the Zener diode. A Triumph dealer can order part H2237 for you; it's an oversize heat sink with more than the 72 square inches of surface required. On a German or Japanese bike, follow the wiring diagram below. Wire colors will differ, but most motorcycle electrical systems are basically alike. Machines with an energy-transfer system, however, will also need a battery-charging alternator stator, 4CA cam, and MA12 ignition coils.

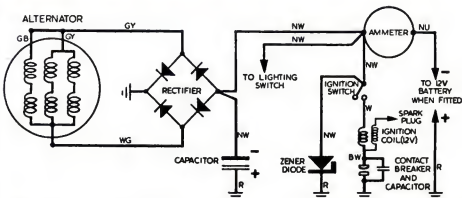
How it's done. Mount the capacitor (Lucas part 541 700 49) with a shock-mounting spring, terminals down. There's a horizontal spring (544 831 56) and a vertical one (544 831 55); examine both at your dealer's, then choose. Put the capacitor in the air stream, away from mud.

If your bike has Lucas electrics, connect the capacitor's negative terminal and the Zener diode to the center (DC) rectifier terminal or a convenient point on the brown/white lead (brown/purple on early models). On older models, *do not* connect capacitor and Zener diode to the ignition coil—former practice. To have the alternator give full output on all switch positions, reconnect it by joining external leads green/black and green/yellow with a double snap connector.

On other bikes, follow the diagram carefully to avoid burning out expensive parts. A Lucas booklet describing capacitor conversions is available through Lucas parts dealers and direct from their depots.



Lucas capacitor replaces your battery or allows emergency starts if it goes dead.



Schematic can be used for any motorcycle that has 12-volt battery ignition. Wire cod-

ing is for Lucas-equipped machines. Connect carefully to protect parts.

What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



▲ Trying out an airlift for aircraft

What's an easy way to move disabled aircraft? Officials at London's Heathrow Airport decided to try an air-cushion Hoverplatform. So they brought this steel-framed 30-footer to the field for a test. With no disabled craft near at hand, they loaded it full of airport workers while three men hauled it around. The unit has a lift capacity of seven tons, but modular versions of it could be mated in complexes of four to 12 units, the maker says, to move aircraft of varying sizes.



TV in 3-D ➤
Multiplex two TV signals on a single channel, and one result could be a 3-D picture. Or you could have two programs on the same channel, with an adapter on your set permitting you to switch back and forth. The DuoVision system can carry a main program in color, a subcarrier program in black and white.



Red writer ▲

All the important features of a standard typewriter are packed into the light (10-pound) and bright (red) Olivetti Valentine. There's a 43-key keyboard, wide carriage that accepts business-size envelopes, keyboard-set tab, half spacing, and a unique carrying case that locks in place with rubber clips.



Enter the '70-plus cars: Firebird, Gremlin (first

What, no bumper on the new Pontiac Firebird (left)? Wrong—the Endura bumper, color-matched to the body, wraps around both grille and headlights. The car shares the Fisher F-body with the new Camaro. This version shows the optional Formula 400 hood with twin air scoops. Heavy-duty front disk brakes are standard . . . Above, look who's come out first with a small car! American Motors has beaten Ford and GM (as predicted last month by PS). The six-cylinder Gremlin comes in one basic body style—a two-door two-seater. Rear seat and opening "tailgate" window are extras. Base price? Probably under \$1,900 . . . Next along is Ford's new Falcon.



▲ Wankel ACV

Now there's a Wankel air-cushion vehicle. The three-seat hovercraft has two Fichtel & Sachs engines—one (12 hp) to drive the prop for forward motion, another (20 hp) to provide lift. Four young men of Stuttgart, Germany, built it. Top speed? 30 mph. Brakes? Cut the lift engine and the thing skids to a stop.

Getting ready: new undersea searcher ➤

Lowered by a derrick through a center well in the bottom of the Alcoa Seaprobe, a string of pipe will descend to the sea floor.

At its end will be lights and TV cameras; or power coring or drilling gear; or search-and-recovery equipment. Four omnidirectional propellers, two forward and two aft, will keep her almost stationary in heavy seas above a target area. "Largest and most advanced deep-ocean search and recovery surface vessel ever planned," the Seaprobe is designed to recover payloads of up to 200 tons from depths to 6,000 feet. Now abuilding, it should be ready for the first sea trials early next year.



the little cars), new Falcon, restyled Camaro

That's right—a Falcon. No longer a separate model line on a 111-inch wheelbase, the Falcon shares the 117-inch wheelbase and body shell with the Fairlane/Torino series. It will be priced to compete with the successful Chevy Nova . . . Chevy's sporty compact for 1970 is a sleek coupe with a striking new front end—the restyled Camaro (right). The wheelbase, at 108 inches, is unchanged; but the nose is two inches longer. Front disk brakes are standard. Two new body features: hide-away wipers, flush-fitting door handles. This year it's a coupe only—the convertible has been dropped.

What's New



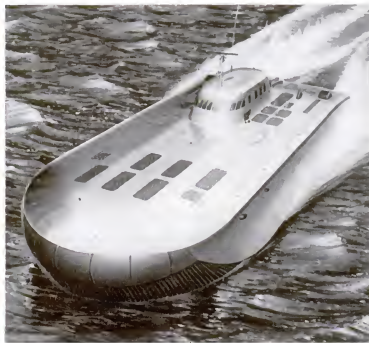
◀ Fiat fun car

How do you keep teen-agers off the roads? One way is to give them this new off-the-road car called the Teen-ager. It's a Pininfarina body on a shorted Fiat 128 chassis. Radio, tape deck, and housing for a CB radio are built into the dash. Lifting the rear seat cushion reveals a lockable compartment for valuables.



▲ Programed parking

Now it's computerized parking meters. This one, made in Germany and called a Parkotron, has two transistorized circuits programed to assess the values of up to three different coins and allot parking time according to their value. Meters are powered by Duracell batteries said to last for a year.



▲ Cat with skirts for high-speed hauling

A catamaran with skirts—that's the revolutionary design being developed by Bell Aerospace for their 90-mile-an-hour, air-cushion ocean cargo ship. Flexible skirts at front and rear will trap a fan-generated air bubble between the side hulls, holding the ship almost entirely clear of the water at cruising speeds. Marine gas turbines will turn super-cavitation propellers at the rear of each side hull. The 100-ton prototype in the drawing will have a payload of about 10 tons. Bell is working toward surface-effect ships as large as 5,000 tons.



▲ Fair-sized speaker

If you guess that 42 squawkers, woofers, and tweeters add up to a barnyard, you're wrong. They add up to a two-ton, 42-unit loudspeaker system made by Pioneer for Expo '70 in Japan. Two of the giant units, each capable of handling 400 watts, will hang 90 feet off the ground, keeping visitors in touch with fair activities.



◀ Two-in-one fun for the RV set

You back this dune buggy down to the water's edge and suddenly it gives birth to a 14-foot fiberglass boat. After the cruise or waterskiing, when you're back ashore, an electric winch hauls the boat aboard its wheeled partner. Dune buggy and boat are powered by the same 50-hp outboard motor. The buggy has standard Volkswagen running gear and an infinitely variable hydrostatic gearbox of the type used on high-power garden tractors. The prototype, a brilliant orange and pearlescent model, appeared at the San Francisco Boat show in January. Created by Brooks Stevens, the Lakester is expected to sell for around \$2,500 when it becomes available.



Expanding camera bag

Here's a camera bag that grows with you. As you add more equipment to your collection you zip open the top of the lid and another compartment opens out to double the capacity of the bag. Straps and carrying handles are reinforced to provide safe support for big payloads. The Milago Omni Bag is made in England.

What's New IN HOME IMPROVEMENT

Mr. Zip ➤

Time was when letter openers looked like ornately styled knives, and you provided the power to run them. This one comes in mini-console form, and three D cells provide the power. Just drop the letters in the tray and the machine automatically zips them open. It's \$9.95 from A-M Buckeye, Box 3176-A, Cleveland 44117.



Instant frost for your windows ▲

Want to play Jack Frost around your home? It's easy with a new self-sticking plastic sheet called MacTac Quik-Frost. You apply it to windows and get a frosty embossed pattern that provides privacy without cutting out light. It's easy to cut with scissors, and easy to apply. Put it on bathroom windows, shower doors, and partitions. It's removable, too, so you can use it for Christmas decoration, take it down after New Year's. It's made by MacTac Pressure Sensitive Products, Morgan Adhesives, Darrow Road, Stow, Ohio 44224.



Easy ell repair ▲

Now you can stop the flow of leaking water, gas, steam, or oil at leaking ells without shutting down the lines to make repairs. Clamp a pair of shell halves lined with contoured silicone packing over the leak, tighten four cap screws, and you're home free. Plidco RepairElls fit iron pipe from 1/2 to two inches.



Candle lantern ▲

You're ready for power black-outs with this telescoping lantern. It holds a candle at the right burning level in a spring-loaded inner tube. A glass wind guard protects the flame and isolates it. \$6.98 from Carlton, Box 12005, Houston, Tex. 77017.



▲ Great new grate

Never mind the kindling—you don't need it with a Sky Litter fireplace grate. Just light a wad of crumpled paper and the upward draft of air from 48 holes in the top of the grate will have the fire going strong in minutes. An electric fan at the front of the grate provides the draft, is detached once the fire is going.

Do-it-yourself security ➤

Just 15 minutes—that's how long it takes to install this home wall safe. It's made to fit snugly between wall studs. Double steel walls and an asbestos lining provide fire and theft protection. Nor-Gee Corp., 4039 Walden, Lancaster, N.Y. 14086. \$39.95.



What's New FOR YOUR CAR

Ear for leaks ➤

Water leaks, and air leaks that cause wind noise, are pinpointed by this new instrument. The Son-Caster (inside) fills the car with an ultrasonic tone, which won't pass through glass, rubber, or metal. If any ultrasound is picked up outside, there's a leak. \$212 for complete Son-Tector 133 kit, Technonics, Box 251, El Prado, N. Mex.



◀ Power package

Driven by excess output from your car's alternator, Pep IV can power tools or emergency lights, or charge batteries in other vehicles—from dead to full charge in 20 minutes, says the maker. Cigar-box sized, it fits under the dash in most cars. Power Electronics, Main Bldg., Houston, Tex. 77002.

Easy-reach nozzle ➤

Rocker panels and fenders rusting away because of road salt your car picked up over the winter? This spray nozzle makes it easy to wash away salt below, or squish off roof-top dirt. A brass adapter fits it to your garden hose. \$2.95 from C. W. Tyner, Box 6003, N. Hollywood, Calif. 91603.



▲ High-temp paint

Want to paint your engine or other under-hood parts? This paint sticks—even on mufflers, claims its maker. It resists up to 1,200 degrees F, comes in white, blue, red, yellow, green, orange, silver, beige and black. The nozzle produces a horizontal spray pattern. \$3.95 a pint from Tempo, 6200 Cochran Rd., Cleveland 44139.



▲ Mini floor jack

Only 25 inches long and a light 42 pounds, this hydraulic jack is easy to operate, but lifts cars of all sizes. It was designed for sports-car enthusiasts and rally drivers, who often need to change tires at the track. It's made by Watervliet Tool Co., Box 350, Albany, N.Y. 12201.



▲ Saddle bags

Fiberglass storage bins fit on top of rear-wheel housings in the Ford Bronco, making good use of that wasted space. Long on top, with one deep leg running down the front, they can hold a number of objects, including some odd-shaped ones. Clark Enterprises, Box 1465, Covina, Calif. 91722.

What's New IN TOOLS



All-angle level ➤

You can use this level at an angle—on either edge, or even flat as in the photo. The vial aren't bent as they are on ordinary levels; a uniform curve is molded inside so you always get a bubble. The 24-inch Craftsman Commercial aluminum level is \$7 from Sears.



▲ Socket to me

A quick-release button on these Craftsman ratchets makes for easy socket changing. The 3/8-inch drive model has an 82-tooth action. Its 1/2-inch big brother has 90 teeth. Both have knurled speeders for rapid turn-down of nuts and bolts. They're about \$8 for the 3/8-inch, \$10 for the 1/2-inch, at Sears.



The heat's on

dual heat element is the secret of this new lightweight, instant-heat soldering pencil. A 180-watt element heats the tip in seconds, then switches off while a 10-watt element holds the soldering temperature—no bulky transformer. IDL is by All Mfg., Kinston, N.C. 28501.

Three-speed saw ▲

If you cut a lot of plastic, fiberglass, or metal, look into this three-speed saber saw. Its special low speed is just right for those materials. High speed will handle wood and tempered hardboard. Medium speed takes care of soft sheet metal and pipe. It's the Black & Decker #7545 Deluxe Jig Saw.



Plastic tray liners

You'll never wash a paint tray again if you use these plastic liners. Just throw them away. Some stores give them free to customers who buy paint and rollers. Others sell them at nominal prices. They'll fit most standard one-inch roller trays. Apple Plastics, Cincinnati, Ohio.



▲ No-slip knife

The interchangeable blade in this technician's knife can't come loose during use—the knob that locks it is at the opposite end of the handle. Hexagonal handle has a deeply knurled grip. The knife is available separately (\$3.50) or in cased kit with extra blades (\$9.50). Ueber Graphic Inst., Box 4, Palo Alto, Cal. 94302.

What's New IN ELECTRONICS



Three-way TV ►

This new portable black-and-white TV works three ways—on 120-volt house power, on its own self-contained nickel-cadmium battery pack, or from a cigarette-lighter adapter. The five-inch light diffuser screen produces bright pictures, indoor or out. It's \$119.95; optional rechargeable battery, \$24.95. From Sears.



◀ Lightweight champ

The world's smallest CB radio is 3½ pounds of performance and power—enough for use as a small public-address system. Refinements include 1F noise blanker and noise limiter to cut ignition noises. Traveller II is made by Courier Communications, 100 Hoffman Place, Hillside, N.J. 07205.



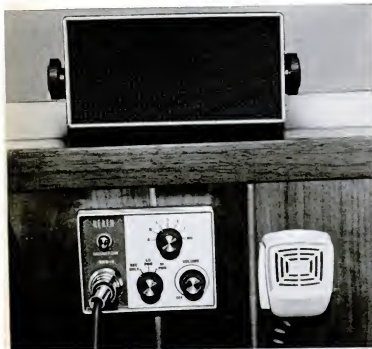
Automatic answering service for the home ▲

"Hello . . . This is a recorded announcement by Jerry Jones. If you'll leave your name and phone number, I'll call you back in a little while." That's what your phone can say if you plug this new home-designed Tensor telephone recorder into your phone jack. The ringing of the phone activates the unit, and both the message and caller's response are captured on a cassette, which can record up to 60 minutes on a side. Transistorized printed circuits improve performance, says the maker (Tensor Corp.), and hold costs down. Built-in safeguards protect against accidental erasure of a message. Price of the unit: \$250 at stores.

What's New IN BOATING

Lightweight dink ▶

Tow it, row it, or hook an outboard on it—Grumman's new lightweight dinghy performs no matter how you move it. Only 83 pounds, the 8½-footer can carry five times her weight. Her full-length keel makes for stable towing; plywood floorboards give her a big-boat feel. The dink is also available in a sailing version.



◀ Law-abiding phone

You get full coverage of both marine VHF-FM bands, with six transmit/receive channels distributable within both bands on this marine radiotelephone. Heath's MWW-18, it's designed around a plug-in control head only 4¼ by 3¼ by 3¼ inches; meets all new FCC regulations. \$49.95 from Heath Co., Benton Harbor, Mich. 49022.

Racy runabout ▶

Want to slice the ocean swells at 50 mph? Look into the new 28-foot Bertram Baron. She's a sport version of the famous Bertram ocean racers. Built for high speeds on rough water, she has shock-absorbing bucket seats, padded cockpit, and full racing instrumentation. Twin MerCruisers or Holman & Moody's provide the punch.

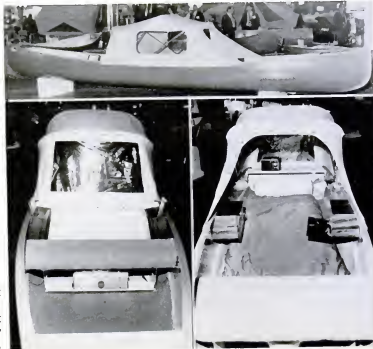


▲ Rubber water tanks

From the Dutch company that makes rubber fuel tanks for NATO Starfighters come rubber water tanks for your boat. The tanks fit where rigid metal tanks won't, adapting to the contour of the space around them. They won't flavor drinking water. Inland Marine, 79 E. Jackson St., Wilkes-Barre, Pa. 18701, distributes them here.

Conestoga canoe ▶

Turn your canoe into a covered wagon of the waterways with this canvas top from Grumman. Top photo shows side view on a 20-foot Grumman canoe. Front view (near right) shows small stove stowed under seat. At far right, sleeping bag is ready for use under cover.



What's New

IN OUTDOOR RECREATION

Earthbound eagle ➤

This Eagle won't fly, but it will climb 45-degree slopes with full 1,000-pound payload, hit 20 mph on land, do four mph on water. Standard Engineering's Eagle ATV has a 12-hp engine, disk brakes, all-steel articulated body with fiberglass upper body. Accessories include vinyl top and side curtains, and a dozer blade.



▲ Fire starter

Concentrate the sun's rays with this 11-inch fresnel lens and you get temperatures up to 2,000 degrees F. That's hot enough to weld, bend, and solder metals—or light charcoal briquets in your barbecue. Or make sun-burgers or sun-dogs. The lens is \$6 from Edmund Scientific, 380 Edscorp Bldg., Barrington, N.J. 08007.

▲ Trailblazing camper

A slide-in camper on Chevy's four-wheel-drive Blazer—that's the new dream unit being shown at RV shows across the country. The idea package (not in production) holds a gas stove, lights, refrigerator, sofa bed, foldout bunk at left side; nearly everything that would be needed for two on an off-the-road camping trip.



No-work fish scaler ➤

Fishing is fun—until you start scaling your catch. The Rock-It keeps the fun in fishing. Throw those lunkers into the basket, tow it a few hundred yards behind your boat, and rotary action does the scaling, maker says. It holds several fish at a time. \$13.95. Ross Enterprises, 837 Glenway Dr., Inglewood, Calif. 90302.

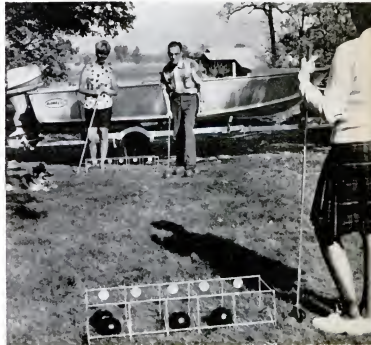


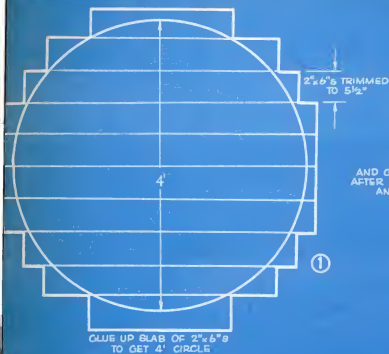
▲ Bike-size camper

A camper for motorcycles? Yup. Its low profile trails at turnpike speed with almost no drag, and its hitch removes bounce and binding in cornering. Set up, the sleeps-two camper extends to 86 inches and the cover stretches over bows as on a covered wagon. Bike-Mate is by Wheel-Mate, Box 34, East Petersburg, Pa. 17520.

New yard game ➤

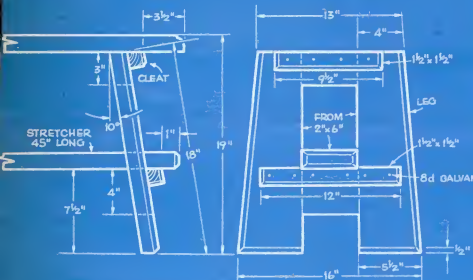
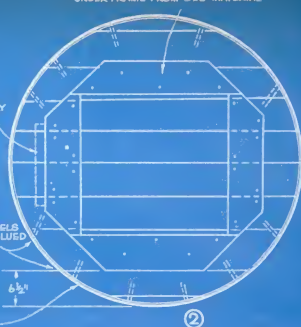
Now you can play shuffleboard on any smooth lawn. You shoot shuffleballs into wire scoring cages, using special wheeled cues. Wire staples anchor the goal cages to the lawn. Kent Sporting Goods, Ashland, Ohio 44805, makes Lawn Shuffleboard.





POSITION OF LEG ASSEMBLY

DRILL FOR AND GLUE IN 1/2" DOWELS AFTER BOARDS ARE GLUED AND CIRCLE CUT



③

LEG ASSEMBLY



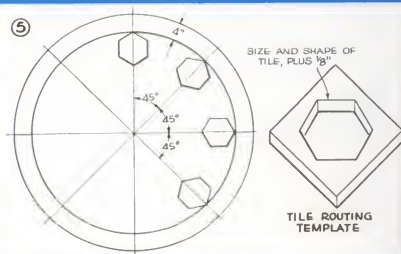
LAZY SUSAN

TRIM 1"x8" BOARDS TO 6" WIDTH



Five stages are involved in building this table—gluing and cutting the top (1), attaching the under-frame (2), cutting and attaching the leg structure (3), making a lazy susan (4), and setting ceramic tiles (5). Inlay strips in lazy susan can be any contrasting wood, perhaps pine or maple. Strips help strengthen the wooden disk.

⑤



HOW TO BUILD A PATIO TABLE with new ideas

By R. J. De CRISTOFORO

Any piece of furniture ought to be both good looking and useful. This table has both of these attributes—and many new ideas besides.

The original was built of redwood for the patio. After it was in use, Lady Cris looked at it one day and delivered her verdict: "Not bad, not bad at all. Now I'd like another just like it—in maple—for the living room." So take your choice of materials.

Material for the original was foundation-grade two-by-six redwood, handpicked at a supply house where I have the privilege of selection in return for a few cents more per foot.

Making the top. Place better sections of the boards edge-to-edge to make a four-foot circle. Cut pieces to approximate length and rip each edge to get a net $5\frac{1}{2}$ " width. Coat the edges with waterproof glue, clamp, do a thorough job of cleaning off excess glue with a damp cloth, and put aside to dry overnight.



After the clamps are removed, cut out the four-foot circle with a saber saw or on a bandsaw. Drill holes for the $\frac{1}{2}$ " dowels indicated for the underframe. Angle and depth are not critical, but do penetrate the second board at least $1\frac{1}{2}$ ". Use a long brush to coat holes with glue, drive dowels, and cut off to suit. This precaution guards against joint separation on these boards. The underframe does it for the others.

Use a belt sander on the edge and both surfaces, working with the grain and changing through a series of coarse to fine grits. Produce the final finish with a pad sander.

Leg assembly. Cut legs and leg spacers to length and assemble with glue and clamps, making a rough assembly that does not include the

tapers or bevel cuts except on the spacers. After the clamps are removed, do the tapers and chamfers on the legs and the top and bottom 10-deg. bevels. Sand these parts, then shape up and attach the cleats.

The underframe isn't fancy but should be installed accurately and with plenty of glue and nails.

Attach leg assemblies, using glue and two 16d nails into the underframe. Cut stretchers to length and form the half-lap joint where they cross. Best bet is to place the stretchers in position and pencil-mark the half-lap joint location. Apply glue to the joint area and to the top edge of the bottom leg cleat and spacer, and put the stretchers in place. Drive a few nails in the joint area and where the stretchers meet the legs.

Install tiles by making a template and forming the cavities by working with a portable router. Use glue to set the tiles, then fill in around them with a waterproof flexible caulking.

After gluing up the lazy-susan form, rout dadoes $\frac{1}{2}$ " wide by $\frac{1}{4}$ " deep. Then cut out the circle. Glue in inlay strips of a contrasting material. Your hardware store should have the rotating mechanism for the lazy susan. If not, try a mail-order firm that specializes in such items.

The shaped edges are optional, but a nice touch. If you lack the tools, round off the edges by hand.

We did nothing elaborate about a finish; just kept applying generous coats of Rez until the wood would absorb no more. Then we wiped off the excess and let the project dry. Any roughness can be removed with a very fine grade of steel wool.



Ceramic tiles are inset into the table top—or set them flush if you prefer. To inset tiles, rout recesses as in drawing.



Two stretchers crossed under the table give it rigidity. Light circles seen in edge of top are dowels which pin boards together.

Let High-

Build this unit and it will lighten the rest of your weekend workload, too

By R. S. HEDIN



Nobody enjoys washing a car. There are lots better places to spend the weekend than out in your driveway—rubbing and scrubbing with wet and soapy rags. Why not blast your car clean with high-pressure water and eliminate most of that scrubbing?

This car washer gives you the pressure you need to do just that. And its magic wand directs the water in a hard-cutting spray that speeds all those other outdoor cleaning jobs that can spoil your weekends—screens, windows, siding, masonry, yard and patio equipment.

Heart of the washer. A motor-driven gear pump provides the washing power, boosting your home water pressure over 100 pounds. An ordinary soft-bladed impeller-type pump won't work—it can't put out enough pressure for the job.

Mount the pump and the motor on a heavy plywood base. A $\frac{1}{2}$ -hp. motor will work, but $\frac{1}{2}$ -hp. will give you more pressure. Make sure that the motor and pump shafts are aligned or you'll put a lot of strain on their bearings. Shims made from hardboard, under the pump or motor, will help assure alignment.

The pump can turn in either direction, but when you connect the hoses remember that the water flows into the pump around the outside of the gears, not between them.

Water feeds into the pump through a garden hose. You'll have to solder



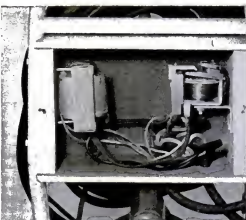
Spray nozzles (from left to right) are: narrow fan, for most jobs; wide fan, for large areas; and round spray, for blasting away heavy dirt. Make them from $\frac{1}{4}$ " pipe plugs.



Wash windows, or brick, stucco, siding—any outdoor cleaning job is easier with high-pressure spray. Clean car engines, too.

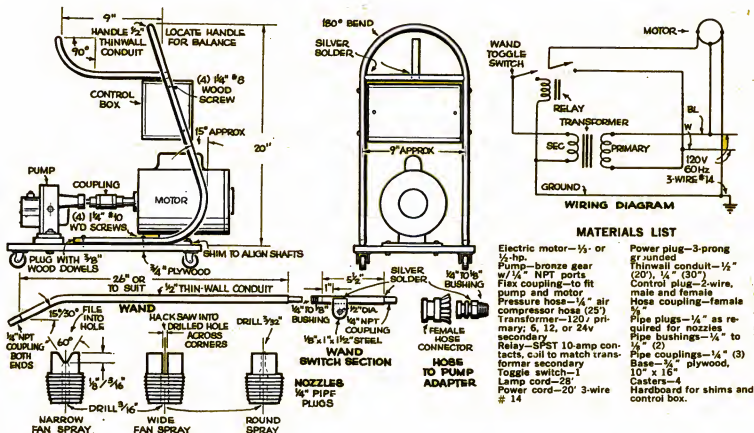


Powerful blast put out by round nozzle is ideal for getting caked dirt off tires and hubcaps. Use narrow fan for the car body.



Transformer and relay, about a dollar each, are housed in control box on carrying handle. See the wiring diagram for details.

Pressure Water Wash Your Car



up a coupling to connect it to the small pump ports. The $\frac{1}{4}$ " air-compressor hose leading to the wand connects with an ordinary pipe bushing.

The business end. A wand made from steel tubing lets you direct the spray where you want it. I made my wand in two sections, a handle and a tip. I use a 24" tip section for washing cars, but attach a longer section to extend my reach when I'm cleaning windows and screens.

Spray nozzles, made from $\frac{1}{4}$ " pipe plugs, screw into the tip of the wand. The three types shown cover most cleaning jobs. Wide sprays cover larger areas but have less cutting ac-

tion than a more concentrated pattern of water.

Nozzle hole sizes are critical—if they're too large, you lose pressure and cleaning action; if they're too small, the motor will be overloaded, and may not even start.

To make a narrow spray nozzle, drill holes as indicated in plans. Cut the groove with a triangular file. The groove should meet the drilled hole to form an elliptical opening about $\frac{1}{8}$ " by $\frac{1}{16}$ ".

The slit in the wide fan nozzle should be as smooth as possible for the most uniform spray. Grind the set off a hacksaw blade and use it to cut

the slit diagonally across the plug.

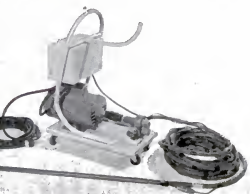
For convenience, the motor is controlled by a toggle switch on the handle of the wand. The switch is connected by lamp cord (taped to the handle and pressure hose) to a low-voltage system powered by a transformer. Flipping the switch activates a relay to start and stop the motor.

This system along with the three-wire grounded supply cord protect you from electrical shock.

To simplify construction you may want to leave this switch out. If you include it, be sure to enclose the transformer and relay in a box mounted on the carrying handle to protect them from stray spray.

The carrying handle and hook to hold the coiled cord and pressure hose are made from thin-wall electrical conduit. You can ask your electrician to make the bends for you, or rent a tubing bender and do them yourself. Braze or silver solder the joints. Prime and enamel the tubing to prevent rusting.

A few precautions: If your pump has no grease fittings it's a good idea to install them. A shot of water pump grease at frequent intervals will keep the pump in good running condition. Never run the pump without water or the gears can quickly overheat. Make sure your electrical system is grounded to guard against shock.



Complete washer unit rolls on casters. A 25' pressure hose gives you enough slack to cover the whole car without moving unit.



Male and female plug let you disconnect the wand from the hose for storage. The 24" wand shown here is good for most jobs.



How you cut threads in wood. Male thread is cut with a die turned about the spindle. Smooth cutting and long, curling chip indicate a good working procedure. Female threads are formed



with a tap much like a metal tapping tool. For a square start, use a drill press. Use quill-feed handle and do turning by hand with bolt in chuck-key holes. Stopblock keeps work from turning.

What Fun You Can Have

And it's easy too, when you buy matching taps and dies made just for that job

By R. J. De CRISTOFORO

Why should you want to cut threads in wood? There are few practical reasons for doing so—but it's fun. And you certainly can raise some eyebrows. Take a look at just one man's output in the photos on these pages.

Threading and tapping wood with-

out special tools might be the greatest challenge. But why bother? There are special tools for the job—and they make it all so very easy.

The tools you'll need: a die for male threads and a tap for cutting matching female threads. Common tool sizes run from $\frac{1}{2}$ " to 1" diameter, with prices ranging from \$20 to \$25 for one tap-and-die set. If you feel that this is expensive, just bear in mind that these are quality tools that will cut miles and miles of thread if not abused.

For latest prices contact such mail-order firms as Woodcraft Supply Co., 71 Canal St., Boston, Mass. 02114;

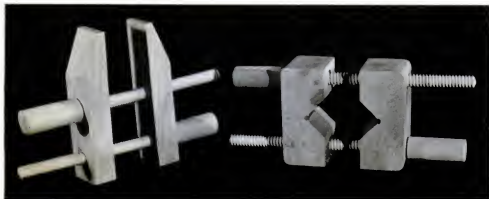
and the Craftsmen Wood Service, 2727 Mary Street, Chicago 60608.

The woods to use. The woods which thread most readily are fine-grain species—maple, birch, beech, cherry, and so on. Ideally, there should be some moisture content—technically about 20 per cent. But since this isn't easily checked in the shop, your best bet is to try a sample of the wood you plan to use. Wood that is too dry has some tendency to crumble and tear but, should this happen, you can get around it by lubricating the wood with light motor oil or rubbing it with a candle. However, oil can stain the wood. To avoid this, soak the stock in water for 30 to 60 seconds.

Most store-bought dowels work well for screw-post material. Diameters are not held to very close tolerances, however, so avoid forcing an oversize dowel into the die. The spindle should be an easy slip-fit. It also helps to chamfer the starting end.

With a sharp cutter, the job is simple and fast. You simply turn the die about the spindle and produce a V-shaped chip which curls out and falls off. The condition of the chip is an indication of the cutter's sharpness. A fairly long chip means a sharp edge. A crumbling chip usually is a sign that the cutter needs attention.

Continued



One practical use for wooden threads is making clamps. V-block at right is good for holding pipe. But since you can't reverse the screw pitch, these clamps do not work like commercial tools. Instead, one hole on each side must be shank-size.



The tools you need are bought in two-part kits—a die for the male thread and a tap for the female thread. Shown here are $\frac{1}{2}$ " and $\frac{3}{4}$ " sizes, left to right. The taps can be turned with regular tap wrenches.



Endless variety of handles for home-workshop projects are among things you can make. Ball handle at the bottom is a drawer pull you can buy in hardware stores.

Cutting Wood Threads!



Nuts and bolts in wood? Sure. If you can tap a hole, you can make a nut—which leads to wooden nuts and bolts, or variations.

For a long-lived, tight joint use threaded dowels in tapped holes. Coat post with glue, and screw into place; also apply some



They can be used for practical and novel applications. If you want a conversation piece, build an outdoor chair with wooden

glue in hole. Another method is to use screw post like a stud. Glue it in; later apply glue to mating piece, and thread it on.



nuts and bolts. Of course, you also use glue. Need a wrench? Make a nut-size U-cut in a strip of wood as shown above.

C-clamps? You can make any size and shape you need. For the jaw width, be guided by the use to which you will put the clamp.





Bookbinder's press is typical of press-type projects you can make. Use the same idea for veneer press and similar applications.



Something different in shelf spacers? Okay—if you want to be different. Otherwise, buy readily available commercial varieties.

The fact that close-grained woods are the best material for this kind of work doesn't mean that you can't use oak or even ash. But you won't get as clean a thread.

Tapping. One general rule about tapping: Don't work down through end grain. Regardless of the wood you use, nine times out of ten you'll get nothing but a rough hole. Whenever possible, let the tap enter from the flat-grain side of the stock. Second choice is to enter the edge-grain side. In any case, the thread you get from the tap will not be as perfect as

the thread you get from the die. This is almost entirely an appearance factor, and since tapped threads are always hidden, it's not critical.

You'll get some tearing where the tap enters and where it leaves the hole: but should appearance be important, you can eliminate imperfections by working with oversize stock and then sawing off a slight amount from each surface. When the stock is too wide to saw, reduce the thickness after tapping by using a sander.

Another solution is to use a countersink at each end of the hole before

you do the tapping. On blind holes, be sure to drill deeper than you need and to retract the tap frequently. If you allow wood chips to pile up, they will interfere with the cutting and will spoil the thread.

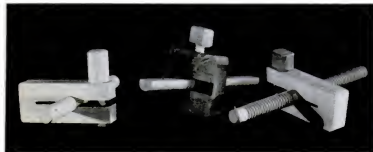
You can judge the size of the tap-hole by the o.d. of the pilot which is the start of the tap. Be sure it can turn freely in the hole. Like metal tapping, the only problem is getting a square start, so the answer lies in a careful beginning. When the tap is small enough, make a start in the drill press, but *not* under power. **[E]**



Some demanding craftsmen thread wooden drawer pulls to face of drawers. If you want the same reputation, here's your chance.



How about half-round spiral molding? Making it from standard maple doweling is a lot cheaper than buying the finished product.



Marking gauges: Center one has screw that bears against a flat on post. One on right has a threaded post and tapped hole.



Bar clamps are a possibility. The general rule, as far as strength is concerned: the longer the clamp, the heavier the bar.

Leadership



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Volero Deep Vee — High performance in roughest waters.

*Patent applied for

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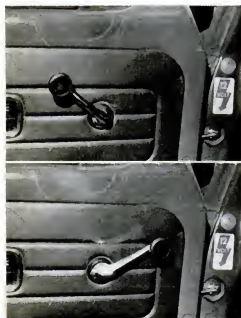
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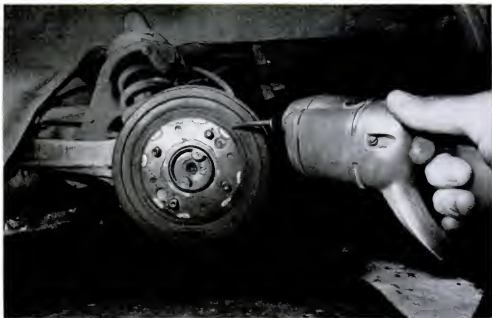
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TAKING CARE OF YOUR CAR



Got a window that keeps dropping open? Take a look at the crank and see if gravity will unwind it when you hit a bump. If so, roll the window all the way up, and reverse the position of the handle.



If you're doing a brake job on your car and come across a drum that just refuses to break loose, don't beat on it with a hammer—you risk denting it out of round or even knocking a crack in it. Here's an easier and safer way to loosen it: Take an electric air impact hammer, chuck in a blunt body hammer or even some soft steel stock. Hold it against the drum and switch on the power. The rapid beat will free the drum in seconds.



If your cigarette lighter stops working, it may be because of a poor ground between the lighter base and the dash. Try twisting a piece of tapered broom handle wrapped with emery cloth inside the socket to clean the grounding surface.



If you have a decal you wish to remove from the painted surface of your car and you don't want to blemish the paint with sandpaper, set up a teapot on a hotplate next to the car and direct the steam on the decal. It'll slide off in moments.



If you have a hard-to-reach bulb in a tail-light, stoplight or under the dash, try this dodge: Insert one end of a dowel into some heater hose, and the other end over the bulb. Bulbs are easy to remove or insert—and no more cut fingers from broken glass.



If you're stranded by the road with a flat and find you've got a frozen lug nut, there's a way to get going again. Pull a flare from your emergency kit, light it and apply the burning end to the lug. The heat will free it in a few seconds.



If you've got a chewed-up oil-drain plug on your early Volkswagen, and you have trouble removing it for an oil change, do this: The oil filter plug on the steering box is the same, so switch them around, and you end up with a brand-new plug.



You may not be able to stop a thief with this hint, but at least you can slow him down. A small sheet of aluminum placed between the vent latch and the window greatly impedes the insertion of a piece of wire thieves use to pop open the latch.

HOME, HOME ON THE ROAD.



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Winnebago Motor Home



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The Best FISHING ROD You Ever Had



How do you get it? One excellent way is to make it yourself, using a kit of parts like those at the right

By JACKSON HAND



They say you catch more fish—and bigger fish—with a rod you make yourself. Maybe this is why the bare-foot kid with the willow stick and bent pin in the calendar picture is always carrying home five or six big bass, while his grown-up companion with

the fancy bass rod has one small sunfish.

Last summer I put the theory to test. Having outgrown the willow-stick class, however, I decided to work with a do-it-yourself kit made by Orvis, in Manchester, Vt. I ordered an

eight-foot split-bamboo fly-rod kit and a seven-foot glass spinning-rod kit (photo above). They offer a full range of lengths and actions in fly, spin, salt-water, and casting rods. This is what I got in the two kits:

Blanks with the ferrules already mounted; full set of guides and tip for each rod; semi-shaped cork grip for the fly rod, and rough cork for the spin-rod grip; several pieces of rod hardware—butt plates, winding checks, reel seats for both rods, etc.; and instruction book. Additional materials that I bought elsewhere included Goodyear Pliobond, white glue, a polyurethane varnish, and some silk "buttonhole" twist thread—about which, more later.

How the grips go on. The cork grips come with a pilot hole which must be enlarged to fit the specific butt blank. I found the easiest way to do this was on a drill press, and I *fed the cork into the specially sharpened bit*, rather than trying to handle the drill-press mandrel in the normal way. The reason: slow, slow feed to prevent the bit from wandering. Since the blank is tapered, I used a rattail file to enlarge the bottom end. By using a slightly too-small bit, I maintained a squeeze fit.

When you start final shaping and sizing of the grips, you discover that no tool is sharp enough to cut the cone without tearing it. I slipped the rough cork disks of the spin-rod grip on a dowel, chucked the dowel into a Shopsmith set up in its lathe position, and did the final shaping with a four-hand rasp.

Grips and reel seats go on in a unit operation. With the spin rod, you

Steps in fitting a grip to your rod



Cork grips have pilot holes but must be drilled out. Keep hole small for a snug fit. Feed drill slowly to avoid wander.



Final shaping of fly-rod grip comes after it is installed. Masking tape on vise prevents scratching the prefinished bamboo.



Easy way to shape spin-rod grip is to shove a metal rod or dowel through it, chuck it in a lathe, and use a rasp as a cutter.



Another way to shape a grip: V-groove cut in a length of two-by-four makes it easy to hold grip and turn it while you rasp.



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2-year warranty: Wheel Horse warrants its tractors & attaching tools to be free from manufacturing defects in normal service for 2 years from date of purchase. (Twice as long as any other tractor warranty you can get today.) The Wheel Horse obligation under this warranty is expressly limited to the replacement of any defective part manufactured by Wheel Horse. The defective part must be returned prepaid through an authorized Wheel Horse dealer. Warranty is effective for 90 days if used commercially. Original tractor & tractor attaching tool drive belts are warranted for 90 days from the date of purchase. The engine & battery carry a separate warranty by their manufacturers. All warranty claims, work, shipment of parts, etc., must be handled through an authorized Wheel Horse dealer. Service calls or the transporting of the unit to & from the dealer are the responsibility of the customer.

take the cork down to a size that will accept the seat at the front end of the grip. Then put the seat on with Pliobond. On the fly rod, the reel seat goes in back of the handle. Here's the operation:

Use a rasp to knock off the corners of the butt at the very end. Drill out

the core of the basswood plug supplied, so it will snug-fit the rounded bamboo. Cement it and the reel seat in place, making sure the reel seat lines up with a flat side of the hexagonal butt (so that guides can be lined up with the reel, later on). Finally, slide the cork grip over the

ferrule and force it down against the reel seat. Secure with white glue. The winding check is a small metal piece that goes on last, snug against the front of the cork. Now you're ready to do the final smoothing and shaping of the handle. The soft texture left by a Nicholson half-round bastard felt better to my hand than a sandpaper-smooth grip, so I left the texture.

Tips and guides. The guides must line up. On the round glass rod, I found it easy to keep them straight by sighting down from the tip end. On the bamboo rod, you keep them all on the same flat side.

The guides must be properly spaced. The instruction book gives correct spacing, and it is important, because it distributes the strain in proportion to the taper and action arc of the glass or bamboo blank as it was designed.

I put the tips on first, using Pliobond. Then I went along the rods and positioned the guides carefully and fastened them securely with masking tape around one flange only. That way, I could wind the other flange without disturbing the position, remove the tape, and wind the other flange. This speeds up the only operation that does tend to get a little tedious.

Before I placed the guides, I took each to a vise anvil and hammered the flanges out to just about zero thickness at the ends. The winding thread then climbs on the flanges easily, without slipping off and causing an uneven wind. You may be able to accomplish the same result by filing the flanges.

The windings. There is a difference in windings between a fly rod and a spinning, plug-casting, or saltwater rod. On the bamboo, you use small, neat winds; on the others you let yourself go with two colors, spiral spacings, and other glamorous tricks. There is a difference in thread, too. A complete angler might choose to use a fine nylon or silk on the fly rod, and a buttonhole-twist silk for the spin rod. My choice, after doing one rod with nylon and one with buttonhole twist, would be to use the latter when it won't affect a light rod's performance. It goes faster, and being a soft thread, it tends to flatten out on the contours of the rod.

Follow these steps in winding a rod:

- Tape the end of the thread near the guide. Make three or four widely spaced turns away from the guide, to the point where the true winding should start.

- At that point, double back and start winding snug turns toward the guide. After three or four turns cut

[\[Continued on page 142\]](#)

The steps that make rod-winding easy



Two styles of guide-winding: above, decorative style is often the popular choice for spinning rods; below, the simple, functional style preferred by fly-rodgers.



A simple rack like this makes rod-winding fast and easy. Make it of half-inch pine, about 10 inches long, six inches high. The dowel below holds thread while you wind.



First, fasten the guides in perfect alignment and spacing by winding masking tape around one flange only, as shown above.



Second, tape end of thread to rod ahead of wind, make two or three turns backward, wind over starter turns, and trim excess.



Third, to end a wind (a color or a complete wrap), run the last four turns over a loop of scrap thread. Slip end of winding thread

through loop, and pulling on loop as above, draw thread back under last four turns and out. Trim excess with razor blade.



Fourth, remove the tape that held guide and repeat other half of the winding. Use dividers to make sure the halves are even.



Last, three coats of varnish. This view of fly rod shows metal winding check and keeper. Third coat fills windings completely.

Run away with home.



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The Crazy, Tricky, Wonderful Sport of Island Hopping

[Continued from page 73]

see from island to island, once you're in their midst, making daytime flying by pilotage dependable. Night flying is strictly by instrument flight rules.

We flew into Nassau International at 11 a.m. It's a major airport—well planned and controlled.

We fueled the Comanche, and filed a three-hour, nonstop flight plan for a tour of Andros. The largest of the Bahama islands, Andros is visible from Nassau and measures 100 miles by (at its widest point) 35 miles.

Eyeballing Andros. We took off, eased into a slow cruise, and headed west for 30 miles to hit the northern end of the island. We were first impressed by the swampy desolation—hundreds of miles of pure wilderness. This reinforced flying-rule number one: Never fly anywhere around here without filing a flight plan. And check in with Nassau every hour.

We zigzagged over Andros, spotting a variety of airstrips. One that was listed, however, simply wasn't there—which brought up flying-rule number two: Always carry plenty of gas and a good compass. Flying without either is an invitation to big trouble. At one point we hit a monster thermal that lifted us 1,500 feet, even with the nose trimmed slightly down. Both Tom and I are soaring pilots, and we agreed we could keep a sailplane up all afternoon in "green" air like this.

The central and southern parts of Andros are more woody than swampy. Fishing here and throughout the Bahamas is said to be fantastic: marlin, dolphin, amberjack, grouper, snapper, bonefish. Wild boar run the western shore of Andros near Timber Creek. Ducks and pigeons galore are reported on the north end at Joulter's Cay.

All afternoon the Nassau omni blinked on and off. We headed back, finally touching down on the new 11,000-foot jet runway. We felt like a mouse in a mansion with our Comanche, which lands with room to spare in 1,500 feet.

Spectacular Exuma. Next day, Hans Groenhoff, Mr. Aviation of the Bahamas, flew with us as guide on a rubberneck tour. We headed down the Exuma chain, 100 miles of islands extending from near New Providence (on Nassau) southeastward to Great Exuma and Little Exuma. This is the most spectacular scenery of its kind I've ever seen.

At the end of the chain, at George Town, Great Exuma, we got our first big taste of crosswind landings, Bahamas' style. Some airstrips were built ignoring the prevailing wind: Bless the bulldozer, and to hell with

pilots forever more. Others are fine. For us, tropical storm Jenny sucked the wind over every strip we considered. Here at George Town we got jostled by 30-knot gusts at right angles to the runway. Even with a cando aircraft like ours, it was no fun.

On many of the out-island airstrips you can be as alone as a cast-away on a one-palm island. On others, local hucksters magically appear in droves. Fortunately, there are genuinely cordial people. One is Capt. Bob Klinge, recently retired from American Airlines. He's been commuting to George Town for years and plans to set up an aero club there soon. You could spend days landlubbing here. The area is packed with history: pirates, barons, slaves, you name it. It may even be the site of the next Spanish-treasure find.

Lunch on Long Island. Taking off, we flew east. Hans asked for the microphone and called the Stella Maris resort on Long Island, using the unicom frequency of 122.8. He asked if they could serve us lunch. The affirmative answer came in happy tones from a German-accented female voice.

Unlike Stateside, unicom here communicates with resorts—often miles from landing places—rather than airstrips. Unicom is used to make or confirm reservations and to summon ground transportation. Another convenience is that Nassau radio has remote pickup stations scattered through the islands.

Tropical boobytrap. As we winged over the Eleutheras and back to Nassau, Hans Groenhoff told how convection-type thunderstorms develop over the islands in summer to boobytrap the uninformed. These are isolated storms that stay put as they grow into huge towers of violence, sometimes lingering over an airstrip for five or six hours. You might hop down to George Town from Nassau, with enough fuel to get there plus 30 minutes—and on arrival find this big, pluming thunderhead. Since every thunderhead you ever saw before follows a course, you wait around for this to move along. After 20 minutes the storm hasn't budged. Now, with 10 minutes of fuel left, you've got Hobson's choice: Try to land in the turbulence, head for another strip, hit the big drink, or prang it on a beach.

With the mobility of the private plane, unencumbered by schedules, you'll meet pioneering people who are remaking the islands. Only 15 of the 700 islands can accommodate tourists now. Imagine what this place will be like in 10 years. As I said, "Wow!"

Your First Ride in an ATV

[Continued from page 46]

to the ground as though embedded in concrete.

After 20 minutes of tearing up-country on a rock-strewn trail, faster than you want to, you relax and have fun. Now I was charging recklessly over the rough terrain, throttle held wide open, depending on split-second jiggles to avoid dangerous obstacles. That wasn't too difficult, actually, but those crazy, forgiving tires had upset all my traditional ideas of what was dangerous. Even if I banged into a boulder or a tree, I'd learned, the impact would be well cushioned.

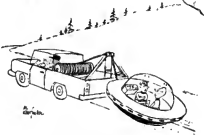
Exploring a swamp. With that full-bore nonsense out of my system, I rumbled more sedately into a tangled swamp at the bottom of the hill. The ATV felt right at home, climbing over submerged logs and rocks, splashing through mud and soft sand.

When a massive barrier of fallen trees blocked the way, I shifted into reverse by moving a handle under the seat. She backed up in the stream bed and I turned in another direction. Marsh grass, saplings, bushes lay down ahead of us as the machine plowed ahead, making its own path through the dense undergrowth. It was like piloting my own movable island through the swamp.

A new way to go. That first ATV ride made a deep impression on me. I've driven others since then, and each time they arouse the same basic emotion: a kind of surprised delight that now you can do things you'd always considered impossible. It's so much fun floating the old rules that apply to other vehicles, you feel sinful.

When I try to describe an ATV's appeal to someone who has never driven one, my language tends to get fanciful. I see an all-terrain vehicle as a kind of floating armchair that whisks you through the roughest country without so much as getting your feet wet. You're in the forest, swamp, lake or whatever, but not part of it unless you step off your protective island. It's like being able to join an adventure picture on TV.

POPULAR SCIENCE



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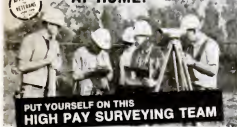


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SHOP TALK

By ROBERT P. STEVENSON

Want to build a bark canoe? Smithsonian book shows how



Those of you who like the challenge of unusual projects should get a copy of a book I've just seen, *The Bark and Skin Boats of North America*, published by the Smithsonian Institution in Washington, D.C. From the rough sketches and photos published there it should be a simple matter to do as the Indians used to do and build yourself a handsome birch-bark canoe. No white birches where you live? Well, you might follow the Indian example and use either spruce or elm bark. These waterworthy craft were often highly ornamented. The sketches show a couple of easily reproduced samples from the Algonkin tribe.

If building a canoe has no interest for you, you might attempt an Eskimo kayak. The final chapter demonstrates in drawings and photos how barely northern paddlers perform the Greenland roll—a procedure for turning a kayak right side up when it capsize.

You can order the book from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price is \$3.75.

Windows of the future look really rosy! Wow!

Now hear this: A man who ought to know predicts that in future years windows will combine the properties of sunglasses, earplugs, electric heaters, and thermal underwear. In fact, PPG Industries already is producing architectural glasses that reduce the sun's brightness, absorb sound, provide auxiliary heating, and insulate against winter's cold. Next step, says James H. Cypher, manager of new-product development for the company's Glass Division, will be a single glass that performs all these functions. And that isn't all the future holds, either. Some future windows may be used as chalkboards and projection screens.

Tip from Ol' Cris: Apply tile adhesive with whisk broom

Our good friend R. J. De Cristoforo, who writes so many of our best shop and project articles, tells me he finds a whisk broom much better than the conventional brush for applying brush-on floor-tile adhesive. "Spreading is easier," he says, "and the little ridges left by the stiff bristles provide better adhesion. Try it, too, for adhesives meant for trowel application. For heavy types, cut the bristles shorter. Clean up the 'brush' with the recommended solvents—or just discard it."

Random reports about interesting things

Could you build a drafting table from one sheet of plywood? A chap in Texas is willing to bet on it. For \$2.95 he'll send you plans and instructions (see sketch). Send check or money order to Julian A. Bell, Box 163, Arlington, Tex. 76010, for Draft-Tab plans... The California Redwood Assn. tells us that A-Grade redwood is now called Clear-Grade.



This is beautiful stuff—entirely free of knots and blemishes... Do the tips of your Phillips screwdrivers soon become chewed up and just about worthless? One company has now done something about that. Specially treated tips are said to have exceptional dimensional accuracy. For further information ask for catalog 166 supplement from Xcelite Inc., Orchard Park, N.Y. 14127.



We build a Chevy Mover for extraordinary use. (The ordinary, we leave for ordinary pickups.)

So it'll do a better day's work than the best of them. And come on stronger when the good times start to roll.

Because of extra power from the biggest 6 or V8 engines provided

in any popular make. And a suspension so smooth and tough it's known as the Bump Exterminator.

This one's something else. You can order it with all the interior niceties of a car and car-like power assists to spirit you through weekend jaunts or suburban chores.

Come to think of it, a Chevy

Mover not only has more going for it than the ordinary truck. It also has more than the ordinary car. Maybe that's why it's living in those one-car garages.



Putting you first, keeps us first.

A lot of Chevy pickups live in one-car garages.

Truck Camper

[Continued from page 83]

one-room apartment: range with oven, double sink, gas-electric refrigerator, stall shower, toilet, gas heater, an infinity of cabinets for clothes, groceries, and souvenirs. Sleeping's for four, with a mighty comfortable double bed—50 by 80 inches—over the cab and a smaller double bed in the dinette area.

Everything worked fine except the water system, which leaked pressure out of the inlet pipe (making hand pumping necessary) and never would fill all the way up to its 30-gallon capacity. A small nuisance—but an argument for a thorough checkout before going on a major trip. The problem you solve at home, where your dealer is, is the problem you don't take with you on the road, where there are no dealers.

Where to stop? South of the border, your choice of trailer camps is limited. The guide book we had was unreliable: It steered us to a couple of pleasant camps, but also listed several "trailer parks" that were non-existent. Tourist bureaus in a couple of cities—Taxco and Guanajuato—found places where we could park and sleep in our camper, but Mexico City was a problem: The nearest camp was 15 miles out. We resolved this by parking the unit in a lot (at 80 cents a day) and living it up at a hotel.

Mexicans tend to be casual about the possibilities of electrocution, and it pays to take a hard look at the electrical hookups when you get to a trailer camp. In only one did I find a three-wire outlet. In a couple of cases, worn lamp cord led to ungrounded outlets—nothing that anyone without plenty of insurance would plug into while standing on wet grass.

Water, water, everywhere . . . You may have similar uneasy feelings about filling your water tank at some spots. We avoided trouble by keeping a gallon container filled with boiled water for brushing our teeth, and packing the fridge with fruit juices, soft drinks, and beer for the thirsty moments. At any rate, we were spared Montezuma's Revenge—a torment that makes a built-in toilet a necessity rather than a luxury.

Camping units of any kind are still uncommon in Mexico, and we attracted good-mannered attention wherever we went. Kids scrambled for the right to "guard" our unit (50 centavos—four cents kept them happy) when we debarked to visit a church, and police went out of their way to find us parking spots. A couple of times, policemen actually hopped into our cab and rode with us to direct us to a spot.

Try to find that in St. Louis or Birmingham or New York! **E**

Space Program for Vacations

[Continued from page 83]

We connected the trailer's electric, water, and drain lines, and unhitched. Nothing left to do then but enjoy it.

Lookit us. "Did you see that new Apache down near the lake?" Several neighbors came ambling over to get a closer look at the Cimarron II. They thought they'd seen them all, but the dentproof ABS plastic corners all around impressed everyone.

The interior layout served us handsomely. Our family of five mostly grown people lived in it and slept well. We could have brought a guest, making six, without severe crowding.

We did find awkward a patent design for converting the sofa into a double bed. Cabinet latches were noisy, mean to use, and unreliable. Storage space is ample inside, and includes a big wardrobe closet—which, however, reduces outside storage to a smallish tool bin. Standard-equipment appliances include a 6 cu.-ft. Dometic gas/electric refrigerator, Thetford freeze-proof toilet, and a 16,000-Btu Duo-Therm furnace.

As old tenters, we liked being able to lock the trailer door without worrying about our possessions while we were away. The smallmouth bass fishing was first class on Winnepesaukee in late July, and I spent hours out on the water, while my wife and children took the wagon off to town for supplies and sightseeing. We stopped at Dartmouth College in the fine old town of Hanover, toured the Connecticut River valley via U.S. 5 on the Vermont side, and at Bath, N.H., crossed the long, old (1801) covered bridge. Driving into Franconia Notch, N.H., we looked up the side of a looming mountain and saw profiled the rock face of the Old Man of the Mountain.

Would we do it again? We'll trailer every time if we can manage it. For one thing, there is a \$260 investment in the top-flight hitch, its frame-welded installation, the wiring harness, and brake controls. We also had a transmission oil cooler installed for \$70. The Apache dealer in Sayville, L.I., who checked us out gave us good advice about towing.

We had our fun, and now we're in good shape for almost any kind of trailering we want to do. **E**



Cimarron II's floor plan: We voted dressing room most valuable feature. There are cupboards above all windows except front.

Pushbutton Camping

[Continued from page 85]

As for space—we were five and fitted in fine for most of our activities, and slept comfortably.

While the power mechanism is convenient and saves tiresome cranking, it is tricky. You have to take considerable care not to raise the roof too fast, in order to prevent the rollers that guide the front and rear walls up and down from binding in their tracks. It's easy to run the rollers out of the tracks if you try to hurry the process.

Once you have the Rolite completely set up, it is a fairly spacious room. It does not have the expansion capability of a tent trailer. But you do have the advantages of hard walls. They are well insulated, and even on cold rainy August nights in Fundy National Park in New Brunswick, I did not find it necessary to turn on the vehicle's heater.

The Rolite 1710, the model I used, has a built-in sink, stove, heater, refrigerator, and clothes closet. It did not have a toilet or shower. We didn't miss them—the sanitary facilities in the Maine, New Brunswick, and Nova Scotia parks we stayed in were quite satisfactory. Cape Breton National Park is particularly outstanding in this regard.

The same 12-volt battery that powers the setup mechanism provides power for lights. I found the two dome lights to be not quite adequate for reading, but sufficient for most other purposes. You can easily carry one of the Tensor-type lamps, however.

Getting this much into a trailer that's still lightweight enough for a compact Mercedes to tow is quite a job. In fact, I was surprised that the little diesel had so little trouble hauling the trailer. I never got off to a quick start, but within a relatively short time I'd have the rig doing over 60 mph.

The steep mountains in Nova Scotia were a bit of a problem when I couldn't get up enough speed before reaching an upgrade. But only once did I have to downshift the Mercedes into first gear to make it uphill.

We covered much more distance than I anticipated, mainly because I didn't expect to haul the trailer so fast with a low-powered car. But we maintained a steady 70 for hours.

It allowed us to spend more time enjoying the fabulous shores along Cape Breton, the Bay of Fundy, and the Maine coast. It's an area that's more suited to walking and sightseeing than swimming. The waters were frigid, but the ruggedness of the coastlines we camped along made it one of the most vividly enjoyable vacations we've ever had. **E**

For your FREE copy of Sears 1970 Fisherman's Catalog, mail coupon to: Sears, Roebuck and Co., Dept. 139, 925 S. Homan Ave. Chicago, Illinois 60607 QZ

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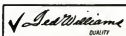
Drinks or catch stay cold in this ice chest. And the top's a cutting board.

Rod storage grooves, rod holders, carrying handles—they're molded right into the boat.

Hull and gunwales are one solid piece of fiber glass. No seams or rivets to leak.

Fishing boats used to be pretty much alike.

Then Sears and a marine engineer came up with "The Gamefisher."



This check mark and signature certify that Ted Williams, Chairman of the Sears Sports Advisory Staff, personally tested and approved "The Gamefisher."

Sears wanted to take a scientific approach to fishing boat design. So they asked a marine engineer to do something unusual: design a 12-foot fishing boat—and do it in fiber glass.

It worked. He came up with a unique hull design that makes this boat ride steadier in any kind of water. But there was one problem. There was no existing way to make a fiber glass boat this unique and lightweight. Sears had to find a new way. And they did. This boat was molded into one solid piece of fiber glass by a new method.

Then Sears had one of America's most experienced fishermen check it out. That's Ted Williams. And Ted said, "It's got everything any fisherman could want."

Tomorrow, see this great boat, "The Gamefisher," at the Sears Sports Center in a Sears, Roebuck and Co. store. Or in the Catalog.

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where the new ideas are



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Planing tool for everyone • shaves wood, metal, plastic • no adjusting • clog-proof cutting edges • essential as a hammer—try it! • plane type, about \$4.55



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Posh Pad For Family Safari

(Continued from page 81)

supplies, fuel, and groceries, we probably weigh somewhere in the vicinity of five tons."

On a weight-station scale for trucks alongside the highway in North Carolina, our Glastron motor home, with passengers and spare diapers included, weighed slightly more than 9,000 pounds. My respect for both my wife and the vehicle increased.

Construction. Although it is concealed from view, the Glastron has a complete "safety cage" of heavy-duty two-inch steel pipe surrounding the fiberglass exterior. Your family is protected in the event of an accident by four roll bars and two horizontal impact-crash bars welded to the chassis at 10 points.

The exterior is a one-piece hand-laid fiberglass outer body that is laminated to the safety cage for extra strength. There's two inches of fiberglass insulation between the fiberglass body and the ceiling and inner walls; there's one-inch high-density fiberglass in the engine hood to muffle noise and contain motor heat.

Underfoot, you have four-ply-sandwich floors with one-inch styrofoam and wood, plus a fiberglass undercoat for insulation, soundproofing, and

durability. Wall-to-wall nylon carpeting is amazingly impervious to stains and easy to clean—as Bambi discovered when three-year-old Phillip spilled a can of Hawaiian Punch.

Camping out in luxury. While in Florida, one of our stopovers was at the new Salt Springs Campground in the Ocala National Forest. Bambi drove 22 miles to Silver Springs, where the kids fed the deer and attended a "shootout" at neighboring Six-Gun Territory. Meanwhile, I rented a skiff and outboard and fished on the Salt Springs River.

Changing our motor home from a wanderer to an installation with "roots" involved nothing more than plugging into electric power and attaching a water hose. With a bit of practice, it became less than a five-minute job.

Securing the kids' toys and breakables was a bit more of a problem, admittedly. It's necessary to put everything fragile in place—much like aboard a small boat in choppy sea.

In summary. With a price tag of nearly \$12,000—without options—the new Glastron motor home certainly can't be described as a budget item. (For current price and dealer infor-

mation, write Glastron Motor Homes, Box 6249, Austin, Texas 78702). This is a futuristic streamliner, the kind of rig that swivels heads and engenders envy everywhere you go. Equipped with a five-kw Onan generator with remote starting, an extra 25-gallon fuel tank with tank-selector control, floor-to-ceiling dividing drapes, and a few other convenience comforts, it's a rig that will take you anywhere from Alaska to Florida's Key West.

I favor a luggage rack, outside ladder, and an observation/sun deck as a virtual necessity for warm-weather traveling. If you have children, the Monomatic toilet eases the "dumping" problem that otherwise crops up at inconvenient times.

There's a double dinette bed up forward; an L-shaped sofa bed and fold-up bunk aft in what Glastron calls the "family den." There is sleeping and more than ample living space and storage for a family of four. You can double up and stretch things to provide for more, according to need.

The major drawback: This rig makes spur-of-the-moment trips so inviting that you're likely to shirk your daily job—at least, once your motor home is paid for!

LE

Two Mountain Weeks in a MiniHome

[Continued from page 81]

plies it.) The first night, even figuring how the bed folded out was a problem. The conversion shrewdly utilizes every cubic inch of space, so the pivoting front seats must be in precise position to let the full-size springs and foam mattress extend flat.

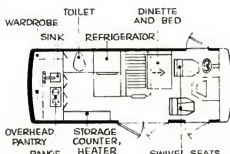
Lack of instruction probably also explains why I never got the pressurized water system to work properly. There's a 30-gallon tank underneath the rig that took great patience to fill. The pump—supposedly an "automatic-demand" type—protested noisily whenever it turned on, and delivered only a dribble at the faucet. Unless something was out of whack, I'd say this extra wasn't worth its \$200 tag. But the faucet worked fine with a hookup to a city system.

There is no holding tank. Sink water drains directly out the rear of the van, over the bumper. This means you must place a bucket here—or dig a "gopher hole," where permitted.

Choose your options. The basic conversion adds \$2,000 to the cost of the van, so the total price starts at just over \$4,800. You can run that up nearly \$1,500 with options, many of which you don't need in summer.

Basic kitchen equipment includes

a stainless-steel sink, an icebox, and a portable stove. Two options, here, were welcome: The Norcold electric refrigerator (\$200) operates off the van's battery on the road or at rustic campsites but switches over to 110



volts when you're hooked up to outside power. And the built-in Trav'ler three-burner butane stove with its glass-door oven: \$147 plus \$69 for the butane system.

Sleeps how many? Now—about those extra bunks that let the MiniHome "sleep five." Even rolled up on their long pipes, they clutter up the floor space. Though the pipes set into neat wall sockets at the forward end, to

support the rear you must hook a chrome bar across the kitchen area—at a fine height for braining. I carted the bar on the floor, too, and tossed the whole mess under the rig after parking at each campsite. I found the short bunk that hooks in crossways above the driving seats (\$30 extra) is handy for a child. But I'd skip the others. If your family is five, the MiniHome's too small for you.

For a pair of travelers, however—or a couple with one or two small children—the floor plan is unusually spacious. It provides true motor-home walk-through from the front seats so that, on the road, the passenger can easily pivot out of her seat and walk to the rear kitchen to stop a rattle.

Visibility rates high. Since the driver is perched over the front wheels, there's no portion of the road ahead that isn't easily seen. The big mirrors on right and left show both sides of the vehicle. And—boon of boons—the big kitchen windows let you see right through to the road behind via the inside rear-view mirror.

At night, interior lighting is excellent, with a high-intensity reading lamp above the dinette/lounge area.

[Continued]

and other sharpies



Front Loading Knife

Change blades quickly and easily without taking knife apart. Blade locks in three cutting positions and retracts for safe storage. About \$1.75.



Slim Knife

5 different shaped blades store in handle. For whittling, slicing, trimming, cutting, shaping, chiseling, carving. Handles like a pen. Only 1 3/4 oz. About \$1.89.

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Two Weeks in a MiniHome

[Continued]

There are ample appliance outlets.

The ride is smooth and stable, thanks to an unusually long (123.5-inch) wheelbase, wide stance, and twin-I-beam front suspension. The 302-cu.-in., V-8 engine delivers 205 hp and, as with any hoodless vehicle, it's tucked into the passenger compartment. Despite an insulated hood, the hump generates too much heat to rest your leg against it.

The Mark IV Monitor air conditioner, dash-mounted directly over this hump, is an option that was much appreciated in California's central valleys and across Nevada.

Trip average: 13.4 mpg. After "How can I get one?" the question I was most asked by fellow campers was "What kind of gas mileage do you get?" Put an air conditioner into any car and the question becomes tough to answer. Naturally, when the travel temperature forces constant use of the cooler, your mpg plunges. Simmering San Joaquin Valley pulled me down to 10.7; but when I'd shut off the air conditioner, I racked up over 15 mpg. For the trip as a whole, I averaged 13.4—and since the Mini's happy with regular, gas expenses needn't fret you. The tank holds 24 gallons, and I filled it at approximate 250-mile intervals.

Yellowstone was supposed to be the trip's climax, with only a routine drive on to Billings to drop the rig. But the road beyond the park's northeast gate provided the ultimate adventure. U.S. 212 looks innocent enough on the map—and no advance warning was posted of the construction ahead. But once we'd climbed to timberline, the highway degenerated into a muddy track, abandoned by the road crew—a section of steep switchbacks, with guardrails removed. There was no turning back; any alternate route lay miles behind, with a stormy night closing in. I gritted my teeth, clutched the wheel, and urged the MiniHome upward, knowing that if I slipped over the edge I'd keep rolling until I splatted into the river along the bottom of the valley yawning several thousand feet below.

Edging her way, at an angle, up mile after mile of slick incline, with a spray of mud for her wake, Mini came through. When we topped the 11,000-foot pass and hit pavement at the Montana border, we realized we were alone on the roof of the world—the last car to make it through.

It ought to be a federal offense to leave a major tourist route in that condition over a summer weekend, but it certainly proved a final test for the MiniHome. I'd drive it anywhere with confidence. **CE**

The New Mechanical Heart

[Continued from page 66]

able batteries, steam engines, hot-gas engines.

As with the boosters, electricity to recharge the motors' batteries or the engines' heat reservoirs could be supplied by induction. New York University has developed a transformer that transmits 30 watts through the skin. Recharging of an electric powered heart's batteries might be completed in 40 minutes. A user would then be free to go about under his own power for perhaps eight hours before another recharge.

Perpetual-energy sources. Ultimately, a total mechanical heart may well dispense with any outside source of energy whatever.

One solution could be an implanted fuel cell, a kind of electric generator that can produce current from the action of various chemicals, like oxygen and sugar in the blood.

But many consider a heat-generating nuclear canister the best hope for an implantable perpetual-energy source. It opens possibilities as way-out as an artificial heart with an atomic-powered steam engine!

Favored by the Atomic Energy Commission, which has been collaborating with NHI on a nuclear heat source, is a capsule of a radioisotope called plutonium-238. It would steadily emit heat, with a minimum of undesirably penetrating gamma rays and neutrons. (Too much of this kind of radiation ruled out an alternate candidate that had been proposed earlier, promethium-147.)

To gauge the effect of the added heat in the body, the AEC has supplied two plutonium-238 heat sources to NHI, which has implanted them in dogs. One source generates 16 watts of heat; the other, 24. At last reports, more than a year later, both dogs were doing fine.

Should nuclear power prove the answer for a mechanical heart, it's foreseen that the artificial-heart program could become the biggest radioisotope user of all. A heart pump calls for one to five watts of mechanical power, or up to 30 watts of heat. If 200,000 people are fitted with artificial hearts yearly, enough plutonium-238 would be required annually to supply about 6,000 *kilowatts* of power.

One day, the artificial-heart researchers' miniature hardware will be perfected; their power supply unlimited; their packaged system wholly implantable, controllable, inexhaustible. When that day comes, the harvest will be golden. It will bring new usefulness and happiness to the lives of hundreds of thousands of heartsick Americans. **CE**

The Best Fishing Rod

[Continued from page 116]

off the loose thread of your starting turns. On a fly rod, you'll continue with this winding, and fasten the end as described below.

● About four turns from the end of the wind (whether it is the complete job or a color change) take about four inches of thread, form it into a loop, and wind it under the last four turns, with the loop extending beyond the end of the wind. Cut off the thread with a little to spare and tuck the end through the loop. Now pull on the ends of the looped thread and you'll pull the winding back under itself—snug and tight. (It helps if the little loop is a thread of a different color.)

● If you're doing a two-color job, use the same technique for the second color. If you use the spiral-wound motif, switch from tight to loose spacing for the proper distance, then back to tight spacing.

● At the point where the winding starts to climb the flange, I find it best to make a turn or two without too much tension. When a couple of turns are well established, pull them tight. At the point where the loop of the guide starts to rise, end the winding as above. With one end of the guide now securely fastened, you can remove the tape from the other end and repeat the operation until the windings are complete.

Two tricks. I found it effective to tighten the winding by shoving the turns tight against each other with a thumbnail... and to coat the wrapping with a clear fingernail polish to act as a binder so it won't come loose while you are doing the other half. The polish also tends to prevent the thread from darkening too much when it's varnished.

At the tip and at the handle, the rod should have a double wind. Start about a quarter inch from the tip and wind toward it. When you reach the tip, double back over this winding, and go beyond it for half an inch or so. Use the same technique at the handle, but wind in the keeper loop—a place to hang fly or plug when the rig is at rest.

Varnishing comes last. I prefer a polyurethane varnish, and it takes three coats to make a smooth job. Extend the varnish a little over the ends of the thread windings on to the rod itself.

I could hardly wait for the varnish to dry. Early in the morning I hit my favorite fishing hole. By noon I had a dandy little sunfish in my creel. Next to me on the edge of the pool, though, there was this barefoot kid with a willow stick. **CE**

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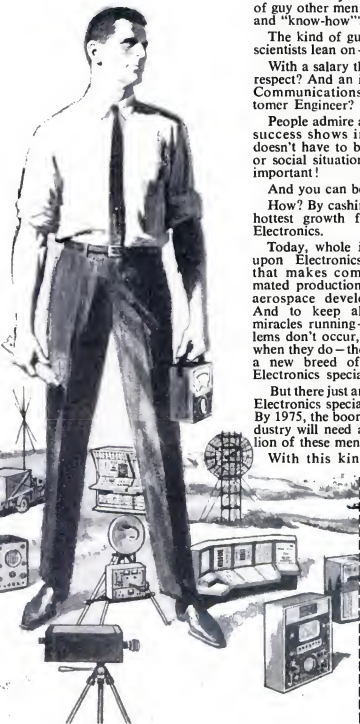
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PS-46



How You Can Enjoy SURROUND SOUND NOW

Convert your tape machine to play four channels at once and thrill to double stereo

By ROBIN LANIER

I've just spent the most exciting afternoon I ever had with recorded music. As I settled in my chair, a double-bass player started up just behind my right shoulder, a guitarist and drummer over my left shoulder, a pianist at left front, on the opposite wall, and sax and trombone at right front. They swung into a rollicking rock rhythm. Then Joan Baez came on loud and clear a little right of center and led the group through the exhilarating folk-rock number *Love is Just a Four-Letter Word*. When they all played together I went for a wonderful ride right in the middle of the group—great!

Then, to find out what this new kind of tape recording would do with "serious" music, I listened to parts of Handel's *Jephtha* and the *Requiem* of Berlioz. The instant the Handel started, the walls of my living room flew back and I was in a large concert hall; the music had the liveliness, space, power, and enveloping quality a good concert hall supplies.

No symphony orchestra had ever sounded like that on a recording before: strong, solid, lively—with a real-

ly big space around it. The Berlioz had the same big-hall sound and, in addition, the various brass sections were in the four corners of the room where Berlioz intended them to be.

These listening experiences, and quite a few similar ones, came from some of the first recordings using a radically new technique that the recording industry has started to introduce this year. Called "simultaneous four-channel stereo," it is a big leap beyond the two-channel stereo we've had for a decade.

Only a few four-channel recordings, and only a few machines to play them, were on the market as this was written, but the supply of both will expand. Four-channel is going to be an extra-choice system for a long time: Today's two-channel stereo will continue to be the standard, perhaps for a decade, and many recordings will be issued in both forms.

Get in on it. The adventurous audio fan will want to get in on four-channel stereo as soon as possible. The least expensive way to do it, if you already have a good tape machine, is the way I did it—by converting your present tape machine to play the new tapes.

After the conversion, you can still play your two-channel stereo tapes—the two systems are compatible. Besides a simple conversion on your tape recorder, you need two more channels of amplification (assuming you already have the two of a stereo playback system) and similarly two

more loudspeakers, for a total of four.

Four-channel stereo, in other words, means exactly that—four complete playback channels, instead of the two we've become used to over a decade of stereo. The four tracks on the tape are all listened to at once, instead of two at a time, as they are on today's standard "4-track stereo" tapes. Four loudspeakers are placed around the listener, typically in the four corners of the room, so that two of them project sound from behind.

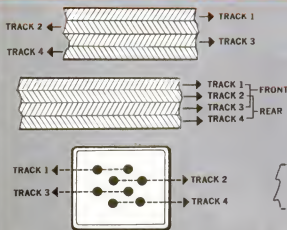
Truth in sound. The main reason for pushing from two channels to four channels can be discerned in the listening experiences I described at the beginning.

In a concert hall, an essential part of the quality of the sound comes from the reverberation—the complex reflections that strike the listener from all directions. The sense of being enveloped by sound in a large hall, and in addition the full richness and power of the sound, depends on hearing all the elements of the reverber just as they come, with some timing, strengths, and directions, including those from the rear. Having four channels, with two in the rear, gets us very much closer to the true hall sound than two channels can.

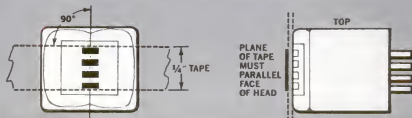
For popular music, having four channels supplies a multitude of effects, with sounds that can come to the listener from all four corners of the room rather than just the front.

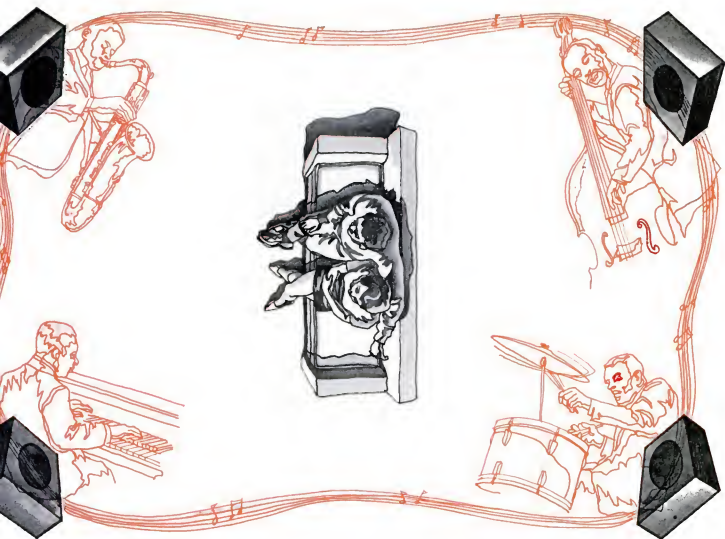
Like to try it? Here, in detail is

All tracks of four-channel tapes travel one way. Here's how to install a head to play them



Track arrangement on standard four-track, two-channel stereo tape differs from that for four-channel play, as shown at left. Top: tracks 1 and 3 carry one program, played in one direction; tracks 2 and 4 carry second program, played the other way. Four-channel tape (below, left) uses all tracks at once—1 and 3 for front speakers, 2 and 4 for rear. Diagrams at bottom: left—each horizontal head pin connects to one track; center—tape must bridge stacks in head with equal overlap top and bottom; right—head adjustment screws must be set so vertical planes of head and tape are parallel.





ot into four-channel stereo. Any experimentally-minded listener who had at least a little experience in making connections in electronic equipment can do it readily.

ape-machine conversion. It consists of substituting a four-channel playback head for the two-channel head every stereo machine has. The two-channel head I used was the Nortronics 5603 (it cost \$110). Michigan Magnetics also markets a two-channel playback head.

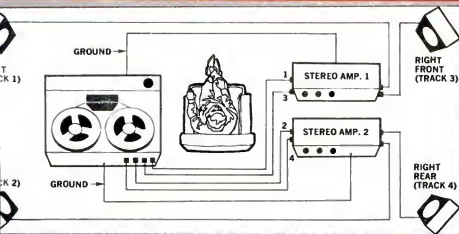
On many machines, the Nortronics head will fit right into the brackets that hold the two-channel head. That was true on the machine I converted—the Viking 807 tape player. This machine has a playback head only; there is no recording head—no electronics of any kind. But any machine with a separate playback head (that includes, of course, all the three-head tape decks and recorders) is a good candidate for the conversion.

If the bracket that holds the old

head can't be adapted for the new one, it's practical in most cases to anchor the new one with epoxy adhesive or GE Silicone Seal—the latter worked fine for me on a second machine I converted.

The main steps are pictured, and described in the captions. The only sticky part of the whole job is the handling of the tiny pin connectors that make the electrical connections to the head. Luckily, the two cables already in the Viking can be used

Connecting tape machine, amplifiers, and speakers for four-channel use



Two shielded cables go from jacks 1 and 3 on tape machine to left and right tape head inputs on "front" amplifier; two go from jacks 2 and 4 to left and right inputs on "rear" amplifier. Left and right outputs of front amplifier go to left and right front speakers, rear amplifier outputs to rear speakers. Note: Left, at rear, is to listener's left as he faces front. For clarity, diagram shows front and rear speaker pairs widely separated. In use, they'd be paired on short walls of room (sketch above). Ground wires, to kill hum, go from tape to both amplifier chassis.

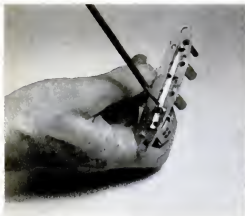
Main steps to convert for four-channel play



Pull two sets of connectors off head pins after removing head assembly cover. Treat connectors carefully; they can be used for two of the channels on new head. Note how far head projects into tape path so that new head can be put in same position. Keep track adjustment control on panel in "Q" position throughout steps of conversion.



To remove old head, back off the two Allen screws on which it pivots, using tiny Allen wrench. Also loosen azimuth adjustment screw to left of head (viewed from front). Old head should push out of bracket. Push new head in, with small plate on top, to same position as old, and retighten screws. (This step may differ with make of machine.)



If old head is hard to remove, lift off entire bar and loosen bracket screws from below. With new head in, adjust Allen screws so tape bridges stacks and is parallel to head face (sketches on previous page). Adjust azimuth screw so head axis is perpendicular to tape axis. Adjustments are interdependent; go back and forth until right.



Turn machine over to open bracket holding two output jacks; install new dual jack beside old one. Prepare two shielded cables, seven inches long, with two inner conductors. Make no connection to shield; put pin connectors on one end of each. Be sure solder doesn't run into slip-on section of connectors—it will block them off pins.



Feed new cables through machine on same path as old. Connect open ends to two new jacks. Mark old jacks 1 and 3, new ones 2 and 4—and note numbers at pin ends of cables. Put new cables under metal tab in bracket, just like old ones. Connect cable 1 to track 1 on head, and so on. Put all "hot" conductors left, all grounds at right.

for two of the four channels—the pin connectors are the right size. Moreover, the Viking connectors have tiny plastic collars over them as insulation.

If you put the insulated sets on channels 2 and 4, as specified in the captions, you will greatly reduce the chance of a short between connectors. There's hardly room between the pins on the head for insulation on all the connectors. (Attention, Nortronics: If you spaced those pins a trifle further apart the job would be easier).

The head is symmetrical: Either end can be at the top. When you put the cable connectors on the pins, put all the "hot" leads (those going to the centers of the output jacks) on one side, and all the "ground" leads (those going to the shells of the jacks) on the other. This keeps all the channels in the same phase.

The Viking helps the job along at

another vital point: The new phono-plug jack you need for the additional channels will fit right in the bracket, alongside the two existing jacks.

By marking the jacks *one, three, four*, and connecting each to the cable from the corresponding track on the head, you can instantly assign any track to any channel your amplifier with external speakers plugged into the appropriate jacks at each end. On the tapes released so far, the assignments are: track one, left front; track two, left rear; track three, right front; track four, right rear.

How about the electronics? You get together your four channels of amplification in a lot of ways. The results, according to present thinking, depend on having all four amplifiers alike, to make sure the signals coming out of them are all in perfect "in phase". You will get a part of the effect, though—particularly with popular music that jumps from corner to corner—even if the "rear" channels use a different stereo amplifier, not so refined or powerful as the "front" amplifier.

If you already have a stereo amplifier with "tape-head" inputs, the way to do the job, everything considered, is to buy another just like it.

For those unfamiliar with recorder terminology, a "tape-head" input and a "tape" ("tape recorder") input are two different things. With a tape-head input, the amplifier takes the tiny signals directly from the playback head, since the amp includes the preamplification and equalization that must be applied to those signals. A tape input lacks a preamplifier and equalizer, so must be in the tape machine.

Since my Viking has no electronic tape-head input for each channel, it was necessary on my system in case I used two stereo receivers. I used two stereo receivers—Scott 348B's—which were available. This model has microphone inputs very easily converted to tape head inputs; but this complicates

[Continued on page 149]

Don't want to convert? Here's what you can buy

Four-channel tape machines: Telex Sonic 230-QQ (no electronics)—\$550; available with built-in amplifiers at price; Wollensak 6154 Quad/Stereo (includes amplifiers)—\$500; Teac A-40 (four-channel recording and playback complete electronics)—\$639.

Four-channel amplifier: Scott 499—\$600.

Four-channel tapes: Vanguard has released about a dozen, including those mentioned in text. They run around \$8 each.

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Circle 10 on Reader Service

Probing the Moon's Interior

[Continued from page 58]

any rocket-powered stage or vehicle is called Δv , pronounced delta vee. For a given rocket stage, it increases with the amount of propellant carried by the stage. It is intimately concerned with the mechanics of a lunar landing—for which the forward velocity of the LM must be progressively reduced from moon-orbiting speed to zero at touchdown.

In Apollo 11 and 12, the LM descent engine did it all, in this fashion: The LM separated from the CSM in a circular lunar orbit of 69 statute miles' altitude. It fired its descent engine for a Descent Orbit Injection (DOI) maneuver, which put it in an elliptical 69-by-nine-mile orbit. At this orbit's lowest point, the LM fired its engine a second time for Powered Descent Initiation (PDI), to eliminate horizontal velocity in its final descent to the lunar surface.

In Apollo 13, by contrast, the Service Module engine will provide the DOI velocity change required to enter elliptical orbit. The LM descent-stage tanks thus will be still untapped at PDI. The LM propellant saved will be available at the end of powered descent for extra hovering time before touchdown.

After a few revolutions of the CSM through the 69-by-nine-mile ellipse, the Command Module pilot will fire up his Service Module engine again and climb back to his original 69-mile-high circular orbit. In this circular orbit, the LM will ultimately rendezvous with him again.

"Hybrid" trajectory helps. Aren't we "robbing Peter to pay Paul" by reducing the Δv reserve of the CSM to increase the LM's hover reserve? We are indeed—but we can afford to, because the Service Module now has a comfortable extra reserve that we can tap. This results from having ended for good, after Apollo 11, the "free-return" feature of the lunar-approach trajectory.

Apollo 8, 10, and 11 sailed to the moon along a trajectory that would have thrown the astronauts right back to earth, had the service propulsion system failed to fire up and brake their craft to capture in a lunar orbit. Effective with Apollo 12, this free-return feature was given up in favor of a so-called "hybrid" trajectory. This trajectory will not carry the spacecraft automatically around the moon and back to earth, in case of a service propulsion failure. However, the crew can still turn the craft around and fire up the LM descent engine to drive the CSM/LM home.

Approaching the moon in a hybrid trajectory rather than a free-return

one has the advantage of reducing the Δv requirement of the service propulsion system. The fuel saved can now be used for the additional DOI maneuver by the CSM, which preserves valuable hover fuel for the LM.

Activities on the moon. Apollo 13 will spend about 35 hours on the moon. Two "moonwalks," again of three to four hours each, may take the two LM astronauts as far as $\frac{1}{4}$ of a mile from the landing spot—more than twice the outward range of Apollo 12's excursions. (A roving vehicle extending the astronauts' radius of action to about 15 miles will await Apollo 17, still some time ahead.)

Once more, the astronauts will collect a wealth of lunar specimens. All they do will be thoroughly photographed, and everybody seems confident that this time the color TV—complete with zoom lens—will work.

The astronauts will leave behind them a new nuclear-powered lunar observatory. Besides the added heat-flow experiment, it will include all the instruments that Apollo 12 put on the moon before: a seismometer, a magnetometer, a lunar-ionosphere detector, and a solar-wind spectrometer. A nuclear generator, in which thermocouples turn heat from plutonium-238 into more than 60 watts of electricity, provides power for all the instruments throughout the lunar day and night.

Apollo 13's moon observatory is called ALSEP III, short for the third Apollo Lunar Surface Experiments Package. (Apollo 12's was ALSEP II; Apollo 11's, for the first manned landing, was a simpler version named EASEP for Early Apollo Scientific Experiments Package.)

"Bootstrap photography." Finally, while the Apollo 13 LM crew is on the moon, the orbiting CSM pilot will try to get the very best high-resolution photographs of sites earmarked for future landings—an Apollo procedure known as "bootstrap photography."

The targets accessible for this work are somewhat tied to the location of the landing site of the picture-taking mission. For instance, if Apollo 13 proceeds as planned to the Fra Mauro site, its bootstrap photography will concentrate on the crater Censorinus (prime site for Apollo 15) and Davy Rille (alternate site for Apollo 18). Should Apollo 13 be diverted to its own alternate, Hyginus Rille, its bootstrap target would be the crater Copernicus, the prime site for Apollo 18.

Thus will continue the useful bootstrap photography begun with Apollo 8. For on the moon, just as on the earth, it helps to know what to expect at your destination. ■

Enjoy Surround Sound Now

[Continued from page 148]

ordinarily unnecessary because there are many excellent stereo amplifiers and receivers on the market with tape-head inputs all ready to go.)

Another solution to the electronics problem, if you are starting from scratch, is to buy all four channels of amplification in one unit. The Scott Quadrant listed in our box was the first of these on the market. It has a number of control conveniences designed expressly for four-channel stereo, including a master volume control for all four channels.

The amateur electronics buff will think of a number of other ways to get the four channels. For example, if he has one stereo amplifier without tape-head electronics, he can build a four-channel preamplifier/equalizer, a small unit that will probably fit into the tape machine. Then he buys another amplifier like the one he has. The four signals come out of the tape machine to be fed to the two stereo amplifiers.

Or maybe he has a high-grade tape machine with excellent electronics built in. He can build and install a duplicate of the two-channel preamplifier in his machine.

Those four speakers? Experience so far indicates that the two rear speakers can be different from the front ones, but they should be comparable in quality. I got excellent results with two AR-2x's in front and two AR-4x's in back.

Set-up and operation. With two separate stereo amplifiers, you have an easy way to balance front and rear sounds if one amplifier carries the two front channels and the other the rear two. And, this arrangement preserves complete compatibility with standard two-channel tapes. The only adjustment you must make to play standard two-channel tape is to turn off the rear amplifier.

The main problem in operating the system is getting the volume level in the front speakers equal to that in the rear. With identical amplifiers and speakers you will probably come quite close when the volume controls on the two amplifiers are at the same setting.

A number of the tapes that have been issued include tones or voice announcements at the beginning to help with level setting. You can do quite a good job with these by matching the apparent volume in the front speakers with that in the rear. The Scott Quadrant amplifier has the refinement of a meter on each channel that shows the output level. That's fine, but remember it will tell you how the *sounds* are balanced only if all four speakers are alike. ■

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Keeping up with the astronauts kept most Americans fairly preoccupied during the past year, at least so far as science was concerned, but scientists themselves were keeping busy in other ways. Working at the sites of ancient cities, or under the ocean, or in laboratories around the world, they have been involved in projects vital and fascinating to all of us. To provide an up-to-the-minute review of these newsworthy developments, the editors of TIME-LIFE BOOKS have brought together in a hardbound, profusely illustrated annual a record of the most important events in these fields last year.

The annual includes a wide variety of superb interpretive articles and picture essays. There is an article by TIME Medicine Editor, Gilbert Cant, on the ethical implications of heart transplants, (e.g., When is a donor dead?) and another dealing with the discovery of Sybaris—the ancient Greek colony deemed one of the most important archeological finds since Pompeii. Former LIFE Science Library Editor, Robert Claiborne, writes about the possibility that the world's largest and most majestic mammal, the whale, may be hunted into extinction by the end of the decade. Other articles examine the

slow drift of the continents, pulsars, those stars that emit precisely regular pulses of radio energy and the comeback of steam and electric cars. The five striking picture essays include a study of the geological features of the moon; a discussion of hybrid agricultural products that may provide some answers to the world's hunger problems; and a fascinating look at some African wild dogs which display many of the same behavior patterns that distinguish early man from the other primates. All of this is contained in 192

information-filled pages, 64 of which are in full color. The book is durably hardbound and measures 8½" x 11".

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Product Safety

[Continued from page 59]

not kept very carefully, and they're therefore not necessarily accurate. There is probably no way of telling how many of the reports concerned only smoke from the TV set, and how many were really fires.

But there inconspicuously were numbers of incidents in which, at a minimum, the TV set was damaged. And 10 persons are reported to have died in home fires originating—according to local fire departments and eyewitness testimony—in color TV sets.

Yes—a few thousand cases of smoke and/or fire a year out of some 20 million color sets is a relatively small incidence. But, in the words of Chairman Elkind, "there is no way that the consumer can be warned of the [TV fire] hazard, nor are there any measures that the consumer can take in order to protect himself from these risks. In that sense, it is a *uniquely unreasonable hazard* . . ." [italics ours].

Based on information received from TV manufacturers and other sources, the Commission learned that the flyback transformer, high-voltage cage, AC switch, yoke, and bypass capacitor were the major sites for fires in color TV sets. The Commission invited television manufacturers to meet with it on the problem.

A two-week crash program. The happy result, after a conference on October 31, was a two-week crash program on the part of TV companies to develop improved safety standards. Their engineers recommended beefing up standards related to fire-hazard tests for flyback transformers, capacitors, and yokes—and elimination of flammable components in these areas. However, an independent engineering consultant to the Commission—Tracor, Inc.—said that the industry recommendations were commendable but didn't go far enough. They recommended that all components used in TV sets be either flameproof or self-extinguishing.

J. Edward Day, speaking for the Electronic Industries Association, (which is the industry-wide spokesman for the TV manufacturers) told PS that "we feel the Commission is proceeding responsibly and that the industry is cooperating. We're taking the Tracor report seriously and are probing it in depth."

The Commission is due to expire in June 1970 unless its term is extended, or it is made a permanent body. Whatever happens, Congress' message has come through loud and clear to consumer, government, and industry alike: Product safety is everybody's business. **EE**

Trailing a Tent-on-Wheels

[Continued from page 85]

rode the precipitously steep cable railway to the top of Lookout Mountain and gazed down on Chattanooga from Point Park.

Later we tore south on Interstate 75 to Red Top Mountain Park near Centerville. It turned out to be one of the best campgrounds on our trip. Wooded and hilly, it spread around a man-made lake of coves and beaches. I backed the rig down a steep, rutted road to the lake's edge and we set up among the trees.

Setting up. By now, converting our low-profile box into living quarters was automatic. While I hooked up an electric cable from car to trailer, the others unspooled six latches that held down the white ABS-plastic top. Bergit opened the side door and flipped a switch inside that simultaneously raised the top and slid beds out at both ends.

We set the aluminum screen door in place and zipped the canvas onto both sides of its frame; then snapped the canvas sides to the trailer and extended three adjustable aluminum bows to support canvas extensions over beds and kitchen counter.

Now we set up the inside: raised the kitchen counter with its three-burner stove and sink to working height, swung the closet/heater unit upright, mounted the tabletop on its floor-flange-supported tube, and slipped the seat cushions into place. The whole job took 20 minutes.

Rosemary luxuriated in camping conveniences she'd always wanted—stove, sink, built-in icebox, food and eating-utensil storage space. I marveled at the way our jack-in-the-box popped out into so much livable space. And you could really enjoy the outdoors from inside by zipping open huge windows on every side.

A 425-mile hop on Interstate 75 took us deep into Florida. We set up after dark in Alexander Springs, Ocala National Forest. Next day we lazed around in a spring-fed natural pool with the whitest sand and clearest water we had ever seen.

After visiting with Rosemary's mother on Anna Maria Island near Tampa, we headed home for Sea Cliff, N.Y. The trip up Interstate 95 was punctuated by stops at Cherokee Campground on beautiful Jekyll Island, Ga., and at Lake Teresa, N.C.

Our 13-day trip had covered 3,400 miles on the ground—a job for seven-league boots. Just as I'd hoped, this rig had them. The muscular Travelall towed our low-slung Nimrod at speeds up to 80 mph as though nothing were on behind. For my money, it was an ideal high-speed vacation team. **EE**

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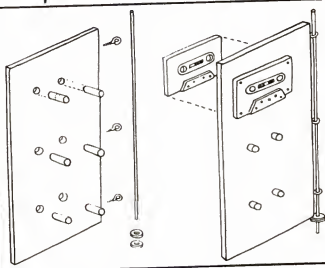
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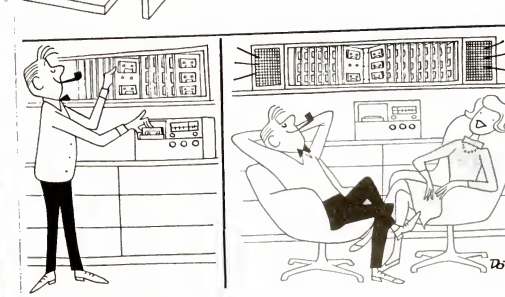
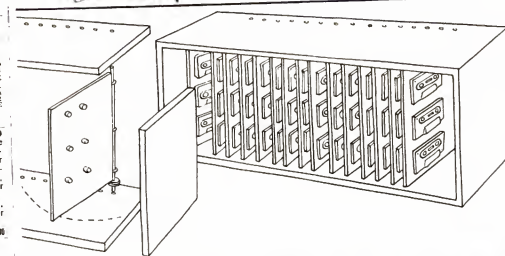
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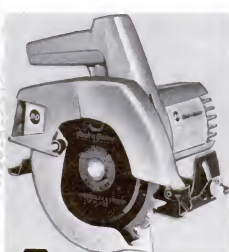


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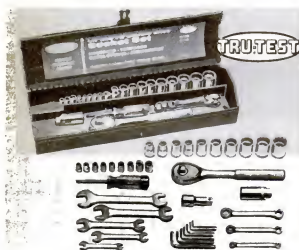
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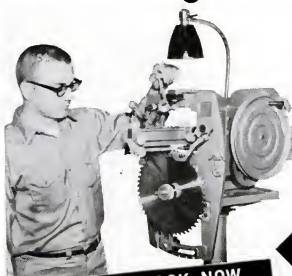
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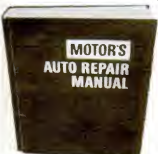
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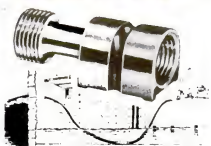
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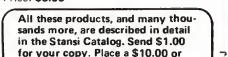
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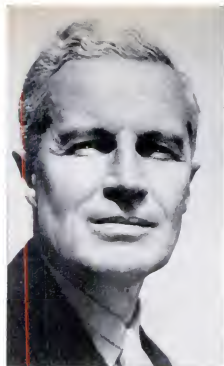


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By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is rubbish! And anyone who tries to tell you that you can think your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be earned! I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest \$15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesman. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

VICTOR B. MASON

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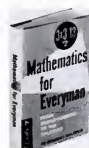
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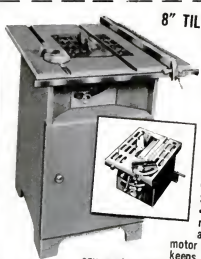
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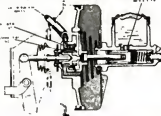
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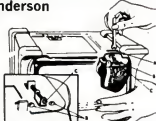
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